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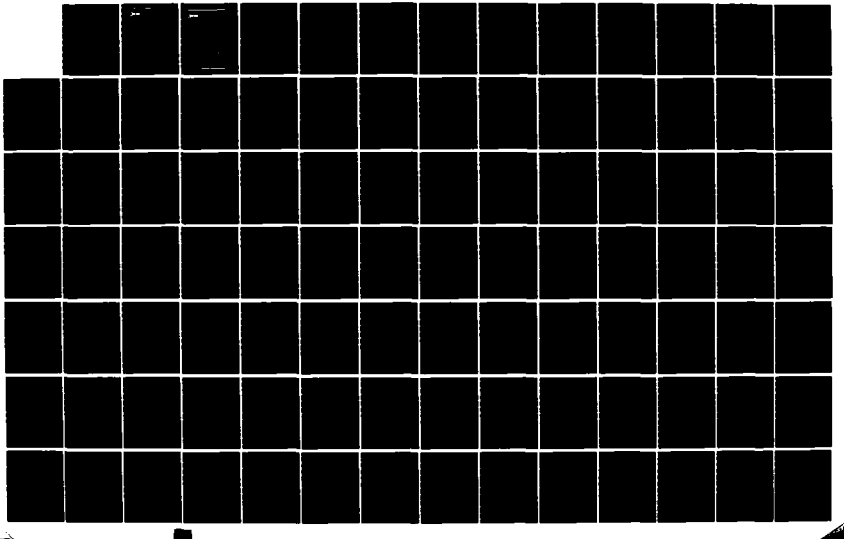

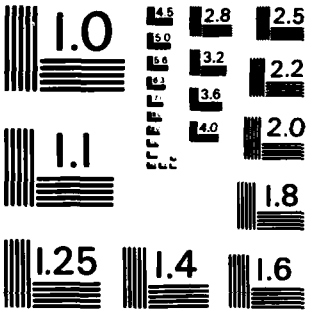

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AD-A162 581

FINAL REPORT
ARMY MANPOWER COST SYSTEM (AMCOS)
ECONOMIC AND BUDGET
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CONTRACT NO. N00014-84-C-0712

JUNE 30, 1985

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been approved

EXECUTIVE SUMMARY

REQUIREMENT

In the past dozen years accurate estimates of the cost of military manpower by Military Occupational Specialty (MOS) and pay grade have played increasingly important roles in manpower planning, personnel management, and weapon system design. Yet existing Army procedures for manpower cost analysis were not intended to address a host of issues of current concern. To rectify this lack, the Army Research Institute is supporting the development of a family of models in the Army Manpower Cost System (AMCOS).

The work reported here has produced prototype models for AMCOS, the Enlisted Economic and Budget Cost Models. This work drew on The Assessment Group's extensive experience in constructing operational manpower cost models for the Navy.

RESULTS

The authors have developed two models, one of which provides budgetary and the other, economic estimates of manpower cost. Costs for all phases of an enlisted soldier's career have been estimated for all grades and skill specialties. A prototype Management Information System (MIS) has also been built to facilitate access to the voluminous cost data produced. Additionally, the MIS has been used to demonstrate application of the models in comparison of the manpower costs of mechanized infantry battalions equipped with either the M113 or the Bradley Fighting Vehicle System.

The results demonstrate that development of the ~~full~~ (AMCOS) is both practicable and desirable. The authors have also identified several areas (most notably training, the MIS, and the Veterans' Educational Assistance Program) where improvement is warranted.

UTILIZATION OF RESULTS

The most significant use of the work reported here is in laying the foundation for the development of the full AMCOS. An added bonus is the immediate utility of the Enlisted Economic and Budget Cost Models in addressing a wide variety of Army problems. For example, the models can be applied by the MANPRINT (Manpower and Personnel Integration) group in the Army Research Institute for calculating manpower-weapons tradeoff analyses as well as by other Army manpower planners for analyzing the effects of changes in force composition on manpower cost.

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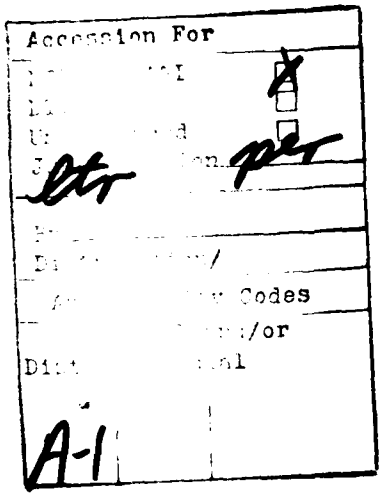

1.0 INTRODUCTION

1.1 BACKGROUND

The Army's desire to develop AMCOS is driven by two events of extreme importance to the Army and, more generally, the military establishment of the United States. The more recent, but more visible, event was the abrupt upward shift of the military labor supply function created by introduction of the all-volunteer force (AVF).

During the years of the draft, military personnel were viewed as essentially cost-free (which was, of course, an illusion), and the armed services paid little attention to personnel cost. This lack of interest explains why cost-estimating tools such as the one described in this report have not been devised before now.

The advent of the All Volunteer Force, as significant as it was, would not have caused such changes in our methods of dealing with manpower if not for another: the rapidly accelerating shift toward technological sophistication in the weapon and support systems utilized by the services. This change has led to significant labor demand shifts for specific types of labor and to more complex career behaviour of soldiers themselves.

Because the most significant excess demands are clearly skill specific, force managers have had to abandon the conventional assumption of labor homogeneity. This specificity shows up in the area of recruiting policy in which the demand for high quality

accessions drives the allocation of resources. It is also evident in other areas like compensation policy that significant retreat from the career-based egalitarian ideal has been necessary.

This climate has created a pressing need for accurate information on the budget cost of military manpower. Such information would be invaluable to manpower planners in the military services as well as to other decision makers in the Department of Defense and the Congress. Accurate estimates of budget costs would facilitate consideration of the effects of force expansions or other changes in force composition.

Designers of military systems need accurate information on the real* costs of manpower that these systems will be subject to before they reach the field. Such information would permit designers to incorporate least-cost mixes of capital and labor in the system design, thereby minimizing the likelihood of unpleasant surprises in the future.

Army manpower planners and budgeteers commonly use the Army Cost Factors Handbooks** for manpower cost analyses. These Handbooks provide budget costs per soldier and distinguish one-time from recurring costs. They do not, however, identify the variations in cost accruing to persons in different specialties and at different pay grades and cannot be used for more finely-grained analyses of the types noted above.

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* The terms **cost**, **real cost**, **economic cost**, **marginal cost**, and **budget cost** are discussed at length in Section 3.

** U.S. Army OMA & MPA Cost Factors, Vols. 1 and 2, DCA-H-1, U.S. Army Cost and Economic Analysis Center, Office of the Comptroller of the Army, Washington, 1984.

1.2 THE ARMY MANPOWER COST SYSTEM (AMCOS)

Recognizing this lack, the Army Research Institute is supporting the development of a family of tools, or models, for estimating manpower costs.* Within a few years, these tools will assist in a variety of analyses ranging from estimates of the effects of force structure changes on cost to estimates of the personnel cost of new weapon systems.

To achieve this, the models will supply estimates of both the real cost and the budget cost of adding or removing manpower positions from the force (marginal cost). They will also supply estimates of the cost of a person with a particular pay grade and in a particular specialty. A set of Life Cycle Cost models will support analysis of the Army investments in human capital through expenditures on accession and training.

AMCOS will deal with enlisted, w rant, and officer members of the active forces, enlisted and officer personnel in the Reserve and Guard components, and general schedule and wage board civil service employees of the Army.

The system will also contain software to facilitate maintenance of data currency, so that annual updating will require minimal resources.

Coupled with other software,** the AMCOS family could eventually provide the core of tools for personnel management in such areas as reenlistment bonuses, pays, and training planning.

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* "Army Manpower Cost System (AMCOS)," Request for Proposals No. MDA903-85-R-0177, 16 August 1985.

** The Assessment Group has developed several models to assist personnel and program managers in their decision functions. Most of

1.3 A PROTOTYPE MANPOWER COST MODEL

AMCOS will require a substantial development effort. To ensure that that effort is wisely directed, the Army Research Institute supported the building of the prototype model described in this report. The Navy's experience in developing a system of billet cost models was exploited as a starting point.* As this report indicates, the Navy experience was only of partial benefit.

1.3.1 The Army Enlisted Position Cost Models

In the present work, we have developed two models, both for FY84. One of these provides budget and the other, real marginal cost estimates. Provision of both types of cost ensures that AMCOS will be applicable to a much wider variety of manpower cost issues than the Navy models and allows re-definition of certain cost elements, avoiding compromises that mar the Navy models.

In general terms, the "model" is, in effect, a very large data set, a census of cost estimates for Army enlisted personnel. We compiled the data from a number of sources, entering some directly,

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(cont'd) these models have been successfully linked to the Navy Billet Cost models as well. Examples include: Neches, T. and D. Opstad, "Bonus Reenlistment Force Transition Model (B/REFT)," PR-A106.6, The Assessment Group, Santa Monica, 1982. Butler, R. and T. Neches, "HARDMAN Program Manager's LCC Handbook: Avionics Equipments," D-201, The Assessment Group, Santa Monica, 1982. Frankel, O. and D. Opstad, "Force Analysis Simulation Model (FASM-2)," D-209, The Assessment Group, Santa Monica, 1983.

* Butler, R. and O. Frankel, The Billet Cost Model System, (NPRDC), R-207, The Assessment Group, Santa Monica, 1984. Frankel, O. and R. Butler, Billet Costs of Enlisted, Officer and Civilian Naval Personnel: FY 84, R-211, The Assessment Group, Santa Monica, 1984.

with minimal revision, and deriving others from source data by applying suitable algorithms. In this work we drew from our experience with the Navy models, modifying the methodology where appropriate and as research resources permitted.

1.3.2 Model Output

The volume of cost data produced by each model is great enough to make paper documentation impractical. Therefore, we have constructed prototype software for a Management Information System (MIS) to facilitate use of the data. The MIS provides access to the cost estimates for each Military Occupational Specialty (MOS) in the Army, displaying these estimates on two pages of computed data. The first page contains estimates of annual economic manpower position costs, the second, estimates of annual budget manpower position costs.

Each page displays costs for every pay grade in an MOS. (See Table 1.1.) Estimates are grouped into fourteen categories for the economic model and eleven categories for the budget model. We believe the categorization by pay grade and MOS will be the most useful for comparative manpower cost and trade-off analyses and the categorizations within this framework (e.g., the S.R.B. category) will capture items of particular concern to Army manpower and personnel managers. Other categorizations are, of course, feasible.*

* There are several hundred types of cost that accrue to the use of manpower. For direct compensation alone, there are 50.

Table 1.1 AMCOS Table for the Enlisted Infantryman Specialty

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS

11B

INFANTRYMAN

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9
1. Basic Pay .	9101	10429	12310	15043	18417	22529	27849
2. S.R.B. .	155	578	462	360	430	713	1061
3. Special Pays .	188	147	202	268	317	149	84
4. V.H.A. .	155	126	194	298	441	613	852
5. Overseas .	106	242	238	216	152	165	113
6. Allowances .	2737	3215	3831	4366	4799	5162	5478
7. Benefits .	188	298	450	784	1235	1247	1032
8. Accession .	4185	3222	1071	7	3	13	3
9. Adv.Training .	0	0	0	978	0	0	0
10. Rotation .	967	1122	712	425	321	517	543
11. Separation .	695	692	480	269	238	375	385
12. V.E.A.P. .	0	0	0	0	0	0	0
13. Retirement .	274	278	483	828	1197	1365	1379
SOLDIER COST .	18751	20349	20433	23842	27550	32848	38779
Down Time Cost .	2901	3148	3161	3689	4262	5082	5999
POSITION COST .	21652	23497	23594	27531	31812	37930	44778

In addition, the prototype MIS facilitates the estimation of budget or real cost of Army units. The user specifies the number of positions for each MOS and paygrade (position type) comprising a unit. Then AMCOS MIS produces tables in the same format as Table

1.1, showing aggregate costs for each unit, adding together all MOSs. These cost aggregates may be shown either as average costs for all members of the unit (by paygrade) or as the sum of all individual costs. The MIS also produces unit composition tables. Samples of these outputs are shown in Section 2 and in Appendix B.

1.4 RESEARCH RESULTS AND SUGGESTED IMPROVEMENTS

The objectives of this phase of development of the AMCOS have all been met and, in some cases, exceeded. The exception has been the exclusion of an estimate for the Veterans' Educational Assistance Program (VEAP), as noted in Table 1.1 and discussed below. In all other areas, however, the project has demonstrated that there is sufficient accurate information within Army manpower and personnel agencies to build useful cost estimates disaggregated by MOS and pay grade.

Improvements can be made in three areas--input data, modeling, and MIS. Identification of these improvements is a major result of our work and is discussed below.

1.4.1 Input Data

Army Manpower Course Cost Data Base (AMCCDB). The training cost component has the most profound effect on differentiating the cost of one skill from another. At this time, however, the AMCCDB, created in the course of this work, captures only 95 percent of the courses provided and 98 percent of the actual student load. The gaps are not uniformly distributed among MOSs; for certain specialties, particularly in the logistics and supply area, training cost information is entirely lacking.

The gaps arise in two ways. First, no data for training provided outside the Continental United States (CONUS) are available in the U.S. Second, although the Army maintains a good record of formal course attendance in CONUS through the Army Training Requirements and Resources System (ATRRS),* course cost analyses are lacking for many courses. While the TRADOC and the Academy of Health Sciences produce cost analyses** for courses they supply, other major training commands do not (DARCOM and FORSCOM).

Complete course coverage is both desirable and feasible. To achieve it, the following steps are necessary:

1) ATRRS data should be examined to assure that they contain attendance data for all formal training provided in CONUS.

2) USAREUR training should be incorporated directly, if possible.

3) Course costs should be hand-inspected. If costs appear questionable or are missing, accurate data should be obtained from the RMS of the responsible command.

4) Where accurate data are not available, a model should be developed to estimate them.

VEAP. Data needed to estimate VEAP costs require the merging of three separate files. These are the Enlisted Master File (EMF)*** or

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* Army Training Requirements and Resources System (ATTRS) Class Schedule and Attendance File, Computer File, Army DCS Personnel, Training Requirements Office, Washington, 1983.

** Course Cost Analysis, (ATRM-159), Resource Management Agency, TRADOC, Ft. Monroe, 1982; Course Cost Analysis, Resource Management Division, U.S. Army Academy of the Health Sciences, Ft. Sam Houston, 1982. Although these are not in the same format as the ATRM-159 reports, they contain the same data.

*** Department of Defense Individual (DODI) Master Enlisted Army, 840331, Computer Tape, Defense Manpower Data Center (DMDC), Monterey, 1984.

an extract thereof, the Education History File (EHF),* and Veterans Administration records showing how much of his education fund each veteran has withdrawn. Severe problems in matching these files have not yet been resolved.

1.4.2 Modeling

Many small improvements could be made in the models throughout, but, by and large, the methods selected seem the best compromise between small gains in accuracy and levels of funding for AMCOS. The modeling of three items should be improved, however, considering the additional work required to do it properly.

Useful Course Life. A procedure should be developed for estimating the useful life of each course to allow proper amortization of the costs of training.

Quarters In-Kind. We have estimated quarters-in-kind costs by attributing a foregone resource equivalent to Basic Allowance for Quarters (BAQ). It is likely that this understates the foregone value of quarters-in-kind. A more complete estimate would be the sum of BAQ and the local Variable Housing Allowance. This revision should be incorporated in AMCOS.

Unemployment Benefits. We used the same unemployment period for an ex-service member regardless of his MOS because we could not find data relating MOS to period of unemployment. There are, however, studies measuring the average unemployment period between jobs

* Education History File, Computer File, Army Finance and Accounting Center, Ft. Benjamin Harrison, current date.

for different types of labor.* We could use these measures by applying the DoD codes equating MOSs with civilian labor categories. Although the results may not be strictly correct for ex-military service members, their application would improve the distribution of the total Army cost to particular positions.

1.4.3 MIS

The MIS now provides access to economic and budget cost by MOS and pay grade, broken down into the categories in Table 1.1 as well as in application to operational units. Further breakdown is feasible and would facilitate analysis in a variety of situations. For example, in many cases it may be insufficient to know that lower rotation costs distinguish a unit equipped in one way from a unit equipped in another. (See Section 2.) Whether the lower rotation costs are due to rotation or to operational or organized unit moves may be pertinent to determining whether savings will be realized if the manpower structure redesign being considered is implemented. This information is in the data base and could be accessed by the MIS.

Similarly, it is quite feasible to separate certain components of manpower position cost by the operational unit type and theater to which the position is assigned. This can readily be done for all compensation costs and for the cost of permanent change of station (PCS) moves.

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* Employment and Earnings, Bureau of Labor Statistics, Annually.

There are also data underlying the position costs that reflect how often a cost is incurred or what proportion of soldiers are eligible to receive certain pays. Access to such data would facilitate a variety of analyses. For example, the Hazard Pay component of the Special Pays category contains the proportion of soldiers with a particular MOS and pay grade who are eligible to receive the pay. This information could be exploited to turn the cost element off or on for new positions in which eligibility for the pay can be forecast. Similarly, if the rotation of a particular unit was known, the MIS could substitute this information for the average rotation rate underlying the cost estimates.

The Navy HARDMAN* program produces manpower costs for skill composites from the array of manpower skills the Navy stocks. The MIS should also be able to do this. This would permit analysis of new hardware systems that require manpower positions whose skill mix does not match any MOS that the Army currently produces.

1.5 REPORT ORGANIZATION

The remainder of this report is organized as follows. Section 2 presents a case study of an application of AMCOS in comparing the cost of mechanized infantry battalions fielding two different types of vehicles. An overview of the Army Enlisted Manpower Position Cost Models is presented in Section 3. Sections 4 through 8 describe the derivation of cost estimates in categories that require

* Frankel, O., "HARDMAN Billet Cost Model," R-203, The Assessment Group, Santa Monica, 1984.

extended analysis. Section 4 treats Pay and Allowances; Section 5, Medical Benefits; Section 6, Accession; Section 7, Training; and Section 8, Retirement. The remaining elements are discussed in Section 9, which also deals with cost totals.

Two Appendixes provide supporting material. The MIS is described in Appendix A, and Appendix B displays tabular material for Section 2.

2.0 AN APPLICATION OF AMCOS: UNIT-LEVEL MANPOWER COST COMPARISON

To illustrate the application of AMCOS we conducted the case study described here. In it, we contrast the manpower costs of the M113 mechanized infantry battalion with the manpower costs of its replacement, based on the Bradley Fighting Vehicle System (BFVS).*

To aid in the cost analyses, we wrote software that would facilitate unit specification and editing. The software is called the AMCOS Management Information System (MIS). It provides detailed cost estimates of user-specified organizational units through access to the AMCOS data base. A description of the software, together with operating instructions, is presented in Appendix A.

The MIS produced the tables shown in Appendix B. They are summarized in Table 2.1. The computations are based on the unit compositions shown in Table 2.2** at the end of this section.

Note first, from Table 2.2, that the BFVS battalion fields twenty additional men. However, both the economic and budget cost totals in Table 2.1 show that the new BFVS battalion offers a manpower cost reduction. The savings, in economic terms, is an annual $738,000, a reduction of 3.8 percent. The reduction per soldier fielded is higher, over 6 percent.

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* Since the AMCOS officer models have not been developed yet, we could compare only the enlisted manpower costs. This omission does not invalidate the comparison, as the officer positions in each battalion were identical.

** Manning data were provided by Department of Army, DCS Personnel, Management and Budget, 1984.

Table 2.1. Comparison of Total Annual Enlisted FY84 Manpower Costs ($'000s) for M113 and BFVS Mechanized Infantry Battalions

COST ELEMENTS	ECONOMIC COSTS M113	ECONOMIC COSTS BFVS	BUDGET COSTS M113	BUDGET COSTS BFVS
1. Basic Pay	9467	9684	9467	9684
2. S.R.B.	280	316	307	346
3. Special Pays	107	26	107	26
4. V.H.A.	147	125	147	125
5. Overseas	151	72	151	72
6. Allowances	2847	2924	1709	1799
7. Benefits	337	342	303	308
8. Accession	1838	1636	52	48
9. Adv.Training	79	67	11	12
10. Rotation	748	371	748	371
11. Separation	383	174	383	174
12. V.E.A.P.	0	0		
13. Retirement	353	359		
SOLDIER COST*	16743	16103	13389	12971
Down Time Cost	2590	2491		
POSITION COST*	19333	18595		

*Totals may not add due to rounding.

The cost tables help us determine the cause of the savings. For example, the essentially one-for-one replacement of 11B infantrymen with 11M fighting vehicle infantrymen in the BFVS position structure (highlighted with arrows in Table 2.2) is by far the largest and most influential difference in the manning of the two battalions.

Table 2.3 displays the economic costs for the two infantry MOSs, 11B and 11M. (Appendix B presents the full set of battalion cost tables produced by the MIS.) Perhaps surprisingly, the major sources of cost savings are in the Accession, Rotation and Separa-

Table 2.3. Comparison of M113 and BFVS Costs in Selected Paygrades and MOSs (Cost per Man, $)

COST ELEMENTS	E-3			E-4			E-5		
	11B	11M	DIFF*	11B	11M	DIFF*	11B	11M	DIFF*
1. Basic Pay	9101	9060	41	10429	10334	95	12310	12419	-109
2. S.R.B.	155	185	-30	578	722	-144	462	447	15
3. Special Pays	188	0	188	147	1	146	202	3	199
4. V.H.A.	155	123	32	126	74	52	194	145	49
5. Overseas	106	8	98	242	19	223	238	18	220
6. Allowances	2737	2782	-45	3215	3234	-19	3831	3847	-16
7. Benefits	188	178	10	298	281	17	450	461	-11
8. Accession	4185	3326	859	3222	2601	621	1071	665	406
9. Adv.Training	0	0	-	0	0	-	0	0	-
10. Rotation	967	35	932	1122	57	1065	712	32	680
11. Separation	695	116	579	692	148	544	480	113	367
12. V.E.A.P.	0	0	-	0	0	-	0	0	-
13. Retirement	274	256	18	278	257	21	483	493	-10
SOLDIER COST	18751	16069	2682	20349	17728	2621	20433	18643	1790

*Difference: 11B Cost minus 11M cost.

tion cost categories which, together, comprise more than 80 percent of the savings at each of the lower three paygrades.

The savings in accession costs decrease with increasing paygrades because fewer soldiers in the higher grades are in their first term, over which accession costs are amortized. Even so, large differences persist even though the same enlistment bonuses are given to both MOSs and training costs are similar. The differences probably arise from differences in average terms of enlistment (11M enlistments are longer) and in attrition (11M attrition is lower); this supposition is supported by the cost savings in the separation category. Savings in these two categories combined account for more than 40 percent of the savings at each paygrade (more than 50 percent at the E-3 level).

The largest single source of savings is in the Rotation cost category; this savings rises and falls across the paygrades. Whether these savings are likely to accrue when the M113 is replaced by the BFVS is unclear. If the high rotation experienced by 11B infantry is caused by battalion moves, for example, then this cost would carry across to the 11M fighting vehicle infantry in the new battalion and there would be no savings.

Another significant source of savings appears under the Special Pays category. Under the current force structure, about 20 percent of the 11B infantrymen receive some form of special pay; very few 11M FV infantrymen do. Whether this will be a real source of savings depends on whether M113 battalion infantry are currently eligible to receive the pay and whether the BFVS fighting vehicle infantry will be eligible for hazard pay.

This analysis points up the desirability of the two additional capabilities of the AMCOS discussed in Section 1. The first would allow a more detailed analysis of the cost components in each cost category. For example, with this capability, an interested user could request an analysis of accession costs, detailing the separate cost of recruiting, enlistment bonuses, equipping, basic and initial entry training, advanced individual (level one) training, and accession Permanent Change of Station (PCS) move costs. The Rotation category could be requested to reveal the separate influence of rotation moves and organized unit moves.

The second desired capability would provide cost disaggregation by type of unit assigned, providing deeper significance to the unit

of manpower, the job position. The uncertainties arising from the case study would, in part, be resolved if access to costs by type of unit were available. The hardware designer, also, would have more valuable design information.

Table 2.2. M113 and BFVS Battalion Manpower Compositions

BFVS vs M113
MECH BN

	07245J220 M113		07245J210 BFVS		
GRADE	MOS	NO	MOS	NO	CHANGE
E9	00Z50	1	00Z50	1	
E9 TOTAL		1		1	0
E8	11B5M	6	11B5M	6	
	11B50	2	11B50	2	
	63T50	1	63T50	1	
E8 TOTAL		9		9	0
E7	11B40	15			-15
	11C40	1	11C40	1	
	11H40	3	11H40	3	
			11M40	16	16
	19D40	1	19D40	1	
	31V40	1	31V40	1	
	63T40	6	63T40	6	
	75Z40	1	75Z40	1	
	76Y40	1	76Y40	1	
	91B40	1	91B40	1	
	94B40	1	94B40	5	4
E7 TOTAL		31		36	5
E6	11B30	36			-36
	11C30	2	11C30	2	
	11H30	10	11H30	6	-4
			11M30	36	36
	19D30	4	19D30	4	
	31V30	5	31V30	5	
	54E30	1	54E30	1	
	63T30	2	63T30	7	5
	64C30	2	64C30	2	
	75B30	1	75B30	1	
	76Y30	7	76Y30	7	
	91B30	1	91B30	1	
	91C30	2	91C30	2	
	94B30	5	94B30	1	-4
	96B30	1	96B30	1	
E6 TOTAL		79		76	-3

Table 2.2. M113 and BFVS Battalion Manpower Compositions Cont.

BFVS vs M113 MECH BN					
	07245J220 M113		07245J210 BFVS		
GRADE	MOS	NO	MOS	NO	CHANGE
E5	05C20	1	05C20	1	
	11B20	78			-78
	11C20	10	11C20	10	
	11H20	10	11H20	6	-4
			11M20	90	90
	19D20	6	19D20	6	
	31V20	1	31V20	1	
	36K20	1	36K20	1	
	54E20	6	54E20	6	
			63B20	1	1
	63T20	16	63T20	13	-3
			64C20	2	2
	71D20	1	71D20	1	
	75B20	1	75B20	1	
	76C20	1	76C20	1	
	76W20	2	76W20	2	
	76Y20	7	76Y20	7	
	91B20	10	91B20	10	
	94B20	5	94B20	5	
E5 TOTAL		156		164	8
E4	05B10	3	05B10	3	
	05C10	1	05C10	1	
	11B10	205			-205
	11C10	14	11C10	14	
	11H10	44	11H10	28	-16
			11M10	205	205
	19D10	12	19D10	12	
	31V10	5	31V10	5	
	36K10	3	36K10	3	
	44B10	1	44B10	2	1
	45T10	2	45T10	6	4
	52D10	1	52D10	1	
	54E10	1	54E10	1	
	63B10	2	63B10	2	
	63S10	1	63S10	1	
	63T10	21	63T10	20	-1
	64C10	6	64C10	12	6

Table 2.2. M113 and BFVS Battalion Manpower Compositions Cont.

BFVS vs M113 MECH BN					
	07245J220 M113		07245J210 BFVS		
GRADE	MOS	NO	MOS	NO	CHANGE
E4	71L10	2	71L10	2	
	71M10	1	71M10	1	
	75B10	2	75B10	2	
	76C10	5	76C10	5	
	76W10	3	76W10	3	
	76Y10	2	76Y10	2	
	91B10	8	91B10	8	
	94B10	10	94B10	10	
E4 TOTAL		355		349	-6
E3	05B10	1	05B10	1	
	05C10	1	05C10	1	
	11B10	96			-96
	11C10	9	11C10	9	
	11H10	20	11H10	12	-8
			11M10	96	96
	19D10	6	19D10	6	
	31V10	1	31V10	3	2
	36K10	1	36K10	1	
			45T10	5	5
	52D10	1	52D10	1	
	63B10	2	63B10	3	1
	63T10	20	63T10	25	5
	64C10	12	64C10	16	4
	75B10	2	75B10	2	
	76W10	4	76W10	4	
	76Y10	3	76Y10	3	
	91B10	12	91B10	19	7
	94B10	7	94B10	7	
E3 TOTAL		198		214	16
ENLISTED TOTAL		829		849	20

3.0 MODEL OVERVIEW

A model of manpower cost could be written in a variety of ways. A model maker must develop information about the kinds of decisions to which model-users wish to apply the estimates. Since this decision content, while rarely unique, is nevertheless varied, it is unlikely that any specific set of assumptions will satisfy all or even most users.

Two steps have been taken to address these problems. First, two different models have been developed, one to estimate real resource costs and another to estimate Army budget costs. According to earlier research, this distinction will greatly expand the potential users of the result.* The second step is to publish a detailed breakdown of the elements of cost. This allows users who have specific cost problems to further tailor the final estimate to their needs.

Both the definitions of types of cost and an overview of the elements of cost are discussed in this section.

The careful reader of the sections covering the equation system of the model will note the central role played by continuation rates. These are the transition probabilities of continuation in the service from one year of service (YOS) to the next. Because they are used in several computations their importance is central to

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* Butler, R., S. Cylke and S. Simpson, "Marine Corps Billet Cost Model," PR-A107, The Assessment Group, Santa Monica, 1981, Section 2.1.

the model as a whole. Accordingly, they are also discussed in this section.

3.1 COST DEFINITIONS

We consider only costs, not benefits (the value of product) that accrue to the expended costs, nor the relative effectiveness obtained per dollar expenditure. As noted, cost has little meaning apart from its components. AMCOS builds cost estimates in two separate categories--real resource or economic and budget cost.*

Economic Cost

The economic cost of a soldier is the highest-valued alternative use of resources consumed as a result of keeping the soldier in the Army for a year. In addition, if an undertaking involves not only alternatives foregone today, but also a reduction of future opportunities, the economic cost would include the discounted present value of all such foregone opportunities in each year to come. The models compute the present value of future expenditures by applying a discount rate of 10%.**

Budget Cost

The budget cost of a soldier consists of the sum of allocated funds associated with his maintenance in the Army during a year. In

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* The ensuing discussion follows Alchian, A., Economic Forces at Work, Liberty Press, Indianapolis, 1977, Part III.

** "Cost Comparison Handbook--Supplement No. 1 to OMB Circular A-76: Policies for Acquiring Commercial or Industrial Products and Services Needed by the Government," OMB, March 1979. In the remainder of this report we will refer to this publication as OMB Circular A-76.

addition to variable costs, a budgetary unit will generally allocate or amortize elements of fixed plant and equipment and other forms of overhead to the individual soldier or position. While all schemes of allocation are logical, they follow no precise theory and cannot, therefore, be summarized in a manner equivalent to real resource costs. The allocation schemes implicit in each cost element are discussed in the following sections.

Soldier Cost and Position Cost

The objective of the cost models is to provide the annual marginal (real or budget) cost associated with a manpower position. By a position we refer to a conceptual standard amount of work required to staff a place, desk or job slot.

We define Soldier Cost to mean the set of marginal costs (again, either real or budget) associated with an individual soldier. This total represents the amount of cost that will be incurred if an individual remains in the service for a year. As such, soldier cost is a subset of position cost, the remainder being the cost of downtime.

The Army is organized by the assignment of personnel to manpower positions in a relatively fixed force structure. Inevitably positions are vacant when, for example, persons are sick, in transit between duty stations, detained or on temporary leave. The Army determines its personnel requirement as the sum of its force structure positions plus the number of individuals* not in position.

* As regulated by Department of Defense, "Programming and Accounting for Active Military Manpower," Instruction 1120.11, April 9, 1981.

This extra amount is required to overcome the downtime accrued during a year of service.

Downtime

The cost analyst working with weapon systems or manpower programs defines his manpower unit of account as a position. In the real cost model a cost is estimated for position downtime. Downtime represents lost productivity, the value of which is assessed as a separate cost element.

The economic model provides both a soldier and a position cost, which differ by the addition of a downtime cost to the position cost total. The soldier cost is a personnel cost, the position cost a manpower cost. The cost analyst using the economic model should take care in choosing whether to use the soldier or position cost.

Sunk Costs

If today's resources were pre-allocated by yesterday's undertakings, no alternatives available today can make use of them. Their value has been foregone by yesterday's decision; they are, therefore, sunk costs and cannot be avoided by any alternatives available today. Since AMCOS includes only marginal costs, sunk costs are excluded.

Sunk costs can be found in sources of cost data, e.g., amortization of the acquisition cost of plant and equipment. We have removed these from AMCOS. Consequently, if the cost estimates are to be used in situations where new buildings or equipment will be purchased, the cost analyst must include their cost directly.

Marginal Costs

We define the annual marginal position cost (either budget or real) as the increment in cost incurred (or saved) by the addition (or removal) of one position from the force structure. In estimating the cost of a position we have been careful to exclude indirect costs or costs that would be incurred regardless of the existence of an additional position. This distinguishes marginal from average cost which is an allocation of total costs across positions.

AMCOS assumes command and administration (C&A) and base operation and support (BASOPS) costs to be fixed. Consequently, if a situation involves the possibility of a change in either of these two functions, the analyst must cost them separately, with the assurance that the AMCOS models will not double count his additions. This is appropriate, because, if a change will affect these fixed costs, it will do so in a unique way, unpredictable from historical changes in either C&A or BASOPS.

Finally, costs to initiate a manpower position (start-up costs) are not included.

Discounting

As mentioned above, in the case of certain cost elements--selective reenlistment bonuses and retirement--we have discounted future costs to their present value in the economic cost model. This makes it possible to compare the relative value of alternative streams of cost. We have used 10 percent as the real rate of dis-

count, according to the requirements of the Office of Management and Budget, published in OMB Circular A-76 and subsequent directives.

3.2 MODEL OUTPUT

We list the fourteen cost categories in the enlisted manpower position cost models in this section together with their respective cost elements and a brief description of their costing methodology. Since the economic and budgetary methodologies differ, we present the economic model first and then touch upon differences in the budgetary model.

3.2.1 Economic Cost Model

Basic Pay

Basic Pay includes not only regular basic pay but also the employer's FICA contribution. An average amount is assessed for each position type.

Selective Reenlistment Bonuses (SRBs)

SRBs are awarded to qualified reenlisting soldiers. The award is the product of the length of the reenlistment term, the soldier's monthly base pay and a multiplier. Eligibility and the multiplier are determined by skill specialty (MOS) and length of service (LOS). Representative reenlistment rates and terms are derived as a function of LOS, and official SRB multipliers are applied. The resulting average LOS amounts are distributed to pay grades in accordance with the current distribution of LOS and pay grade personnel in each MOS.

Special Pays

Special pays include Hazard and Proficiency pays. At present the Army does not distribute shortage specialty Pro-pay; however some duty assignments are eligible for Special Duty Assignment Pro-pay. An average amount is assessed for each manpower position type (hereafter, defined by MOS and pay grade).

Variable Housing Allowance

An addition to Basic Allowance for Quarters (BAQ, discussed below) is available for housing in certain locations. The amount receivable is a location-specific percentage of the soldier's BAQ. An average is assessed for each manpower position type.

Overseas Pays and Allowances

A host of additional pays and allowances are available to soldiers serving outside the CONUS. Eligibility depends upon duty location, length of assignment and family dependents. The amount receivable depends upon pay grade alone. An average is assessed for each manpower position type.

Allowances

In this category we place all other allowances: Basic Allowance for Subsistence (or the cost of subsistence-in-kind); Basic Allowance for Quarters (or the cost of quarters-in-kind); and an allowance for Clothing Maintenance. An average is assessed for each manpower position type.

Benefits

The Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), medical and dental care in Army facilities, and Army use of nondefense facilities represent costs to the Army for each additional soldier. Use of Army commissaries does not represent a cost marginal upon an additional use, and no portion of any associated commissary budget is included.

Existing data on use of each benefit is limited to numbers of patient visits and total costs per annum. We allocate costs to MOS and pay grade by gender and age, using national statistics for medical utilization rates and facility costs disaggregated by gender and age.

Accession Costs

Under this heading we collect all costs associated with preparing a new enlistee for his first duty station. We include marginal costs for advertising and recruiting, accession Permanent Change of Station (PCS) costs, enlistment bonuses, initial equipping, and all initial training required for performance of the first duty assignment. Thus, we place under this heading (not under "Advanced Training") advanced individual training (AIT).

Costing methodology varies from element to element. The total is collected and amortized as a (human) capital investment over the service years of the initial enlistment.

Advanced Training

Here we place the cost of all training subsequent to the AIT (which is required for the execution of a soldier's first duty sta-

tion) and associated PCS costs. An average is assessed for each manpower position type and no amortization is performed.

Rotation Costs

Permanent Change of Station (PCS) costs not entered elsewhere are placed under this heading. This category includes the cost of Rotation, Operational and Organized Unit moves. Accession, Training, and Separation PCS costs are placed under their respective categories. An average is assessed for each manpower position type.

Separation Costs

Separation incurs three costs to the Army: Separation PCS, Separation Pay and Unemployment Compensation. For the first two items, an average is assessed for each manpower position type. Unemployment is modeled as depending upon base pay at separation and MOS/pay grade-specific loss rates.

Veterans' Educational Assistance Program (VEAP)

The cost of the Army VEAP should be included here; in addition to the Army College Fund it would include the cost of offering MOS-specific Ultra-VEAP "kickers." However, these costs have not yet been modeled due to unresolved problems with Veterans Administration data.

Retirement

This cost category includes both disability and non-disability retirement, severance pay and Army costs attendant upon a soldier's

death during active duty. The modeling of these elements is relatively complex; the reader should refer to Section 8, which details the mathematical modeling of these elements.

Downtime Cost

The sum of the cost elements described above comprises the Army cost of an additional soldier, a soldier cost. The cost of a manpower position includes, in addition, the opportunity cost of lost (unworked) time. This is modeled by estimating time lost due to vacations, holidays, rotation, sickness and correction, and by attributing a marginal product value equivalent to the Army personnel cost, the sum of the cost elements above.

3.2.2 Budget Cost Model

We list here only the budget cost categories which differ from those of the economic model.

Allowances

In-kind provisions are costed differently in the budget cost model. There is an Army budget for subsistence-in-kind which we allocate per capita.

While the economic model estimates a resource cost for government-supplied housing (in lieu of BAQ), this provision incurs no expense and no budget is requested. Consequently, in the budget cost model we assign no cost to government-supplied housing.

Benefits

The Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) covers dependents of active duty soldiers, retired soldiers and dependents of retired and deceased soldiers. The economic model estimates the cost of all CHAMPUS claimants and attributes it to the active soldier. Since CHAMPUS requests payment from the Army for active Army dependents only, however, and the funding for other claimants is obtained from the Veterans Administration, in the budget cost model we cost only the service provided to dependents of the active Army.

Accession Costs

Accession costs are allocated to pay grades E-1/2 to E-4 as they are incurred. In the budget cost model training does not impose opportunity cost for the time spent away from active duty, and costs are not amortized.

Advanced Training

In the budget cost model, training costs are allocated as in the economic cost model except that opportunity cost for the time spent away from active duty is not included.

Veterans' Educational Assistance Program (VEAP)

There was no Army budget for VEAP, which was administered by the Veterans Administration. In FY85 and beyond a budget for Ultra-VEAP has been established and in future updates of this model it will be allocated stochastically in accordance with eligibility and likelihood of use.

Retirement

Recently the armed services have been tasked to submit a budget for retirement. However, during the period to which the model refers, fiscal year 1984, there was no such request or submission. Consequently, we have included no cost for retirement. In subsequent updates of the budget model we intend to allocate a retirement cost in accordance with the methodology of accrual accounting chosen by DoD but specific to MOS and pay grade.

Downtime Cost

The downtime cost does not figure in the budget cost model because the Army budgets in terms of personnel, not positions.

3.3 CONTINUATION PROBABILITY AND OTHER PRELIMINARY COMPUTATIONS

Several of the cost elements in this section are stochastically distributed over year of service (and, as a consequence, pay grade). The probability estimate that governs these distributions is the continuation rate or the probability that an individual observed at one point in time in YOS cell n will be observed a year later in YOS cell n+1. A great deal of work went into the development of continuation rates that exhibited (and, in the future, could be expected to exhibit) sufficient stability to be used in the model.

Continuation rates apply to individuals but must be estimated from personnel aggregates. Choosing characteristics around which to group individuals into cells, so that the rates derived provide both numerical validity and forecast reliability, presented itself as the major problem. We have approached this problem by examining which

personnel characteristics most strongly influenced the soldier's decision to remain in the Army.

Factors influencing a soldier's decision to reenlist are many. Empirically the most influential factor appears to be the number of years he has already served. Consequently it is necessary to disaggregate continuation rates by years of service (YOS). The rates also are influenced by the skill learned in an MOS vis-a-vis its marketability in the private sector. The rates are influenced by grade achieved, but the correlation between YOS and grade is sufficiently strong to make disaggregation by this factor unimportant.

Due to small numbers and the complexity associated with statistically tracking the careers from one MOS to another, we had to use the career management field (CMF)* rather than MOS as the skill-level unit of analysis for continuation rates. The marketability of skills should not vary too much within a CMF (except in a catch-all CMF where small number problems would in any case prevent a skill specific analysis).

Several time series studies conducted by the Office of Economic and Manpower Analysis (OEMA) at West Point, New York,** have shown that not only are continuation rates the result of underlying reenlistment, survival and migration phenomena, but also the change in rates from year to year reflects change in the demographic composi-

* MILPERCEN Force Management Books I and II, U.S. Army Military Personnel Center, Alexandria, 1984 was used to map MOSs to CMFs. This source was also used throughout the work to validate the match between paygrades and MOSs and for MOS-MOS conversion patterns.

** The data produced by these studies form the basis of the many inventory forecasts performed by OEMA. Sample data were shown to visiting research personnel from The Assessment Group.

tion of YOS cohorts. Controlling for education, gender, race and mental category, continuation rates have been found to exhibit a time stationarity not seen when aggregated across demographic dimensions.

Two sets of continuation rates were derived for the AMCOS models. One set measures the proportion (for each CMF and YOS) continuing in service from one year to the next. The other measures the proportion remaining in the skill category, CMF. The first set is used in retirement and post-service benefits cost calculations. With the second we may capture the return generated from specific skill training, under the assumption that, upon transfer to another CMF, previous training finds no application.

Two additional DOD Individual enlisted master tapes* were obtained from the Defense Manpower Data Center, Monterey, (DMDC) dated a year apart. An extract was made of the first file, a roll containing social security number (SSN) for identification, basic active duty service date (BADSD) for longevity, and an individual's CMF (deduced from his primary MOS classification). Flags to determine demographic character were also recorded.** This extract was then run against the second tape, the master file dated a year later. A roll call recorded those still present, force losses, and CMF transfers, by CMF, YOS and demographic characteristics.

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* DODI Master Enlisted Army, 820930 and 830930, Computer Files, DMDC, Monterey, 1982 and 1983.

** Demographics recorded were gender, high school graduate status, race and mental category. Due to information carried by the DMDC EMF extracts, our definition of low mental category differed from that used by the Office of Economic and Manpower Analysis at West Point (OEMA).

Accession counts were collected in two ways. In the first, the counts were disaggregated by YOS, CMF and demographic character. The second set was counted according to MOS and length of enlistment--selecting only non-prior service gains.

The first set was used to project continuation rates and to adjust inventories to reflect expectations of force composition five years hence. We chose five years, admittedly somewhat arbitrarily, our best guess for when decisions made using costs from these models would be implemented. Note that the use of a five year projection horizon is not standard to analyses performed by the OEMA, whose staff may use a projection horizon according to purpose. The resulting continuation rates were dimensioned by CMF and YOS five hears hence and by subsequent year of service until each initial YOS cohort was forced into mandatory retirement.

The second set was used to amortize accession investments (basic and initial entry training, initial equipping, recruiting costs, etc.) across the first term. Accession cost estimation is discussed in detail in Section 6.

The following sections provide descriptions of the elements of the cost model categories. Each element's computation, data sources and theoretical problems are discussed in order, and the modeling of real costs contrasted with that of budget costs. In some cases, these discussions are straightforward, as for base pay. In others, the discussion is lengthy and the methodology complex. Both retirement costs and training costs have absorbed disproportionate amounts of time and computational resources in these models.

4.0 DIRECT COMPENSATION

Six of the manpower position cost elements are aggregations of compensations paid on a monthly (or bi-monthly) basis directly to service members. These elements are Base Pay (which includes FICA), Selective Reenlistment Bonuses (SRBs), Special Pays (such as special duty assignment Proficiency Pay, Hazard Pays, Duty Incentive Pays), Variable Housing Allowance, Overseas Pays and Allowances, and a category called Other Allowances which includes basic allowances (BAS and BAQ) and an allowance for clothing maintenance. Everyone--with a negligible exception--receives basic pay, but all other pays are distributed according to eligibility. Consequently we have had to estimate an average position cost for pays where eligibility is not a uniform characteristic of persons rated to fill a particular position.

Our preference where eligibility estimation is concerned has been to address statistical data sources directly rather than to construct, from eligibility rule books, an estimation algorithm. Suitable data was located at the Defense Manpower Data Center, Monterey (DMDC) in the form of two personnel files--the EMFX and the JUMPSX. Since a match-merge of these files has provided most of the data for this project, it would be appropriate to describe them in some length here.

Quarterly submissions are made to DMDC from the Enlisted Master File (EMF) by the Military Personnel Center (MILPERCEN), (DAPC-PSP).

The quarterly EMF is processed and error checked to produce the Department of Defense Individual (DODI) extracts: the Master file (cited earlier) and Loss/Edit file.* The Master file corresponded to a cross-section of the enlisted Army on March 31, 1984; it shall be referred to as the EMFX in what follows.

The EMFX was merged with an extract** from the Joint Uniform Military Pay System maintained for the Army at the Army Finance and Accounting Center at Ft. Benjamin Harrison. Each quarter this extract is sent to DMDC for further distribution and analysis. The extract we used was dated as of March 1984 and reflected the pay raises received at the beginning of January. This extract shall be referred to in what follows as the JUMPSX.

For our purposes neither was sufficient: the EMFX contains no actual pay information; the JUMPSX, while it maintains a record of each soldier's rank and years of service (YOS)--for pay purposes--it does not record his MOS. To render a "snapshot" of actual pays received in each position it was necessary to match-merge these two files by the soldier's social security number (SSN). We shall refer to this constructed file as the master file.

The match was successful. Close to five percent of JUMPSX records were not matched by records on the EMFX because the Army Finance and Accounting Center includes on their extract any soldier

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* DODI Loss/Edit Enlisted Army, 830930, Computer File, DMDC, Monterey, 1983.

** Joint Uniform Military Pay System (JUMPS), 840331, Computer File, DMDC, Monterey, 1984.

on active duty during the quarter. Conversely less than one half of one percent of EMFX records were not matched with records from JUMPSX.

A study was made of fields that were recorded on both files. Pay grade, YOS and marital status were found to differ considerably. Tables 4.1 and 4.2 display the variance found in paygrade and YOS respectively between the two files. Since pay amounts depend on YOS and paygrade, it seemed reasonable to suppose that the JUMPSX data was generally better validated, though proper file evaluation was beyond the scope of the project. Although distinct patterns can be seen in the tables, the cause remains obscure.

Table 4.1. Comparative Paygrade Distribution: JUMPSX and EMFX

Comparison of Paygrades:

		EMFX								
		E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
JUMPSX	E-1	4976	228	155	35	16	1	0	0	0
	E-2	1066	5189	755	77	0	1	0	0	0
	E-3	105	601	12641	592	12	1	0	0	0
	E-4	18	29	830	22797	493	3	2	0	0
	E-5	4	4	29	597	18609	258	5	0	0
	E-6	0	0	3	2	357	13204	15	0	0
	E-7	1	0	1	0	0	30	7925	9	0
	E-8	0	0	0	0	0	0	13	2759	0
	E-9	0	0	0	0	0	0	0	7	742

We compute the contributions to manpower cost for each type of pay. By "type of pay" we mean an aggregation of pays: for example, over 5 overseas pays and allowances are gathered as one. Over 80

Table 4.2. Comparative Year of Service Distributions: JUMPSX and EMFX

Comparison of LOS cells: 1 to 17

JUMPSX \ EMFX	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	25525	117	189	242	77	44	52	31	17	14	9	5	5	1	5	2	2
2	26	11118	122	38	288	113	25	33	18	15	11	8	5	3	1	2	0
3	11	13	8079	93	37	151	57	14	8	13	9	6	2	3	5	0	0
4	13	6	30	6370	71	35	129	45	18	7	9	8	1	5	1	3	3
5	6	5	4	22	6452	51	45	96	38	12	12	8	5	2	3	1	0
6	3	1	9	10	17	5065	51	63	86	32	6	1	2	4	3	3	2
7	1	2	0	4	5	7	4060	40	61	77	34	8	6	3	10	3	0
8	1	0	0	1	3	6	7	2864	21	14	8	2	0	1	0	0	0
9	1	0	1	2	3	4	8	59	2999	12	5	3	2	0	0	0	1
10	1	0	0	1	1	4	3	6	41	2662	7	4	3	0	0	0	0
11	1	0	0	0	2	0	1	2	4	40	2270	9	6	0	0	0	0
12	0	0	1	1	0	1	0	0	1	20	51	1762	9	4	1	0	0
13	0	0	1	0	0	0	0	2	4	14	39	49	1184	9	4	0	1
14	0	0	0	0	1	0	0	3	1	31	57	43	65	1285	10	0	2
15	0	0	0	0	0	0	0	0	0	3	33	36	47	67	1482	7	3
16	0	0	0	0	0	0	0	0	0	0	3	6	16	34	78	1162	7
17	0	0	0	0	0	0	0	0	0	2	1	4	5	20	46	62	1128

Comparison of LOS cells: 18 to 34

JUMPSX \ EMFX	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
18	926	7	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
19	49	955	6	1	1	0	0	0	0	1	0	0	0	0	0	0	0
20	17	29	657	2	0	0	0	0	0	0	0	0	0	0	0	0	0
21	4	9	20	535	4	1	0	0	0	0	0	0	0	0	0	0	0
22	7	14	9	23	415	2	0	0	0	0	0	0	0	0	0	0	0
23	6	4	10	10	25	311	1	0	0	0	0	0	0	0	0	0	0
24	2	6	0	7	9	12	255	0	0	0	0	0	0	0	0	0	0
25	0	1	2	2	8	5	14	181	0	0	0	0	0	0	0	0	0
26	0	2	0	5	1	4	3	10	118	0	0	0	0	0	0	0	0
27	1	1	2	1	1	0	4	5	3	97	1	0	0	0	0	0	0
28	0	0	1	0	1	2	3	4	4	4	79	2	0	0	0	0	0
29	0	0	1	1	0	2	2	4	4	3	6	56	0	0	0	0	0
30	0	0	0	0	1	0	1	0	3	3	1	1	9	0	0	0	0
31	0	0	0	0	0	0	2	1	2	1	2	1	0	1	0	0	0
32	0	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0
33	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0
34	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

pays are suitably collapsed into fourteen categories which are then further collapsed--with some modeling (see below)--into the six regular pay and allowances categories. To obtain mean cost contributions to manpower cost from these pays, we aggregate (during tape processing) both the total of whatever type of pay is under consideration and the count of persons receiving basic pay in the manpower position. The division of the total by the count provides an average of this category of pay received for soldiers in the position type.

The following subsections detail the modeling, computations and data sources used for the direct compensation elements. Certain notations referring to inventories or continuation rates are used consistently below and are defined in advance here.

We have defined the unit of manpower as a position or job slot, classified in terms of both MOS and pay grade. In both models costs are estimated uniquely for each intersection of MOS and pay grade. In the technical discussion that follows we have used the notation "(i,j) position" to mean the class of persons rated as MOS i with pay grade j and "C_{ij}" to be a variable specific to that class. C_{nij} is the cost estimate derived by the models for the n^{th} manpower cost category, each of which is described in the following sections.

4.1 BASE PAY

The Base Pay cost element in both economic and budget models includes both a soldier's Base Pay and the Service's FICA contribution at the current tax rate.

$$(4.1)\quad C_{1ij} = BP_{ij} + \min[FCAP, BP_{ij} \cdot FRATE] \ .$$

C_{1ij} = cost of pay category one, Base Pay and FICA for positions defined by MOS i and pay grade j
BP_{ij} = mean base pay for the position calculated from $BP_{ij} = T_{1ij}/N_{ij}$
FCAP = current maximum FICA payable
FRATE = current FICA tax rate
T_{1ij} = total base pay distributed to soldier filling (i,j) position
N_{ij} = the number of soldiers filling (i,j) positions

4.2 SELECTIVE REENLISTMENT BONUSES

SRB levels for each MOS and reenlistment zone were obtained from the MILPERCEN Force Management books dated as of January 1984.*

In the calculation of the SRB cost, the following computations are repeated and summed for each contractable period, P, of reenlistment.

The rules stipulate that the bonus to be paid is equal to the product of (1) the SRB multiplier, (2) monthly base pay and, (3) the number of contracted years (P), the product being capped at a maximum of $16,000 during FY84. Presently half of the bonus is paid up front and the other half is distributed as equal anniversary payments over the contracted P years. In the economic model the amount distributed requires discounting to the present value at reenlistment, when the resources are allocated. The rate used is the money discount rate** (rather than the real rate) since bonus amounts will not be increased (as will other costs) to account for changes in the general price

* MILPERCEN, op. cit.
** As projected by the Office of Management and Budget.

level. We follow these costs into future grades as the reenlistee is promoted, as discussed below.

The am paid immediately is:

$$(4.2)\quad A_{ijk}(P) = \min[(BP_{jk} \cdot Z_{ik} \cdot P)/2, \$8{,}000] \ .$$

BP_{jk} = monthly base pay for grade j and YOS k
Z_{ik} = SRB multiplier for MOS_i and the zone covering YOS k
P = the period of reenlistment

Define for each i,j,k the probability of being in each grade, G, for each of the following years L, $PG_{ijk}(G,L)$. To arrive at these probabilities we take the percentile range of the $N_{ij}(k)$ inventory in the distribution of MOS i members with YOS k over the grades not less than j and use it as a ruler to find the corresponding percentile range in the similar distribution of members with YOS L. A correction is then made so that the sum of the probabilities $PG_{ijk}(G,L)$ over the possible grades, G is equal to the probability of continuation to YOS L for a member with YOS k.

Then the present cost to each grade, G, of one reenlistment for P years in grade j and YOS k, incurred by the half of the bonus that is distributed as anniversary payments, is:

$$(4.3)\quad B_{ijk}(P,G) = \sum_{t=k+1}^{k+P} [A_{ijk}(P)/P \cdot (1+i)^t] PG_{ijk}(G,t) \ .$$

i = the money discount rate for the economic model (but zero for the budget model).

Let $R_{ijk}(P)$ denote the number of persons reenlisting qualified by i, j, k and P. They incur a cost in each grade of:

(4.4) $S_{ijk}(P,G) = R_{ijk}(P)\{A_{ijk}(P)d_j(G) + B_{ijk}(P,G)\}$.

$d_j(G) = 1$ if $j = G$, and $= 0$ otherwise (Kroenecker delta)

Consequently, the total cost per grade incurred by the $R_{ijk}(P)$ is $T_{ij}(P,G)$, the sum of the $S_{ijk}(P,G)$, for k=1 to 30. Let $U_i(P,G)$ be the sum of $T_{ij}(P,G)$ over cost-incurring pay grades (j=1 to 9), $V_i(G)$ be the sum of $U_i(P,G)$ over the various contractable periods, and P = 3 to 9 years of bonus-eligible reenlistment or extension.

Finally we arrive at $C_{2ij} = V_i(j)/N_{ij}$.

4.3 SPECIAL PAYS

Included in this collection are both proficiency pays and hazardous duty pays. Under Proficiency pays we would include both shortage specialty and special duty assignment propays. The Army currently does not distribute shortage specialty propay--but special duty assignment propays may be awarded to Recruiters, Reenlistment NCOs, drill sergeants and some special forces personnel.

Hazardous duty includes duty under hostile fire, flight crew and non-crew member duty, duty assigned to a permanent parachute position, demolition of explosives (restricted to MOS 55D), experimental stress, and duty requiring the handling of toxic fuel. Diving pay is also included in this category.

An average manpower position cost is attributed:

(4.5) $C_{3ij} = T_{3ij}/N_{ij}$.

4.4 VARIABLE HOUSING ALLOWANCE

This cost element is isolated because of its size and location-specific (and thus indirectly, MOS-specific) variability. The average allowance paid is statistically available through the JUMPS pay records:

$$(4.6) \quad C_{4ij} = T_{4ij}/N_{ij} \cdot$$

4.5 OVERSEAS PAYS AND ALLOWANCES

Included under this title are Foreign Duty pay, Family Separation Allowance, Sea Duty pay, Overseas Extension pay and the Overseas Station Allowances for Cost of Living, Housing and Temporary Lodgings. An estimate of the mean amount paid in overseas pays and allowances is available through the JUMPS pay records:

$$(4.7) \quad C_{5ij} = T_{5ij}/N_{ij} \cdot$$

4.6 OTHER ALLOWANCES

Three additional basic allowances must be accounted for: Basic Allowance for Subsistence (including subsistence-in-kind), Basic Allowance for Quarters (including housing-in-kind) and the Clothing Maintenance Allowances.

Clothing Maintenance Allowances are averaged from the JUMPSX merge. The contribution to position cost is estimated as:

$$(4.8) \quad CMA = T_{6ij}/N_{ij} \cdot$$

Basic Allowance for Subsistence (BAS), is accounted for by allotting to those not receiving a direct payment, a figure for subsistence-in-kind obtained from the MP-A budget submission.

$$(4.9)\quad BAS = [SIK(NP_{ij} - NP_{7ij}) + T_{7ij}]/NP_{ij} .$$

SIK = subsistence-in-kind budget entered in the MP-A*
NP_{7ij} = number of persons receiving directly some form of BAS in pay
T_{7ij} = annual total of all BAS received as cash
NP_{ij} = number of position soldiers

Basic allowance for Quarters (BAQ) is costed for the economic model together with BAQ-in-kind. Four categories emerge from combining marital status (single or married, S or M) and housing status (receiving government quarters or direct BAQ pay, G or B). Let SG, SB, MG and MB respectively denote the number of persons occupying each position in the above four categories. This data is available in the master file.** Also let SP and MP be the amount of BAQ pay directly received by single and married persons, respectively.

Then we derive a mean of BAQ and BAQ-in-kind as follows:

$$(4.10)\quad BAQ = \frac{(SG+SB)SP + (MG+MB)MP}{SG+SB+MG+MB} .$$

There is no in-kind BAQ cost for the budget cost model where the BAQ cost is averaged, by position type, directly from the pay records.

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* Justification of Estimates for Fiscal Year 1984, Military Personnel, Army, Department of the Army, submitted to Congress February 1983. Also referred to as MP-A Budget.

** The master file referred to is the merging of the JUMPSX and EMFX data.

To summarize, the manpower economic cost for allowances is:

(4.11) $C_{7ij} = A + BAS + BAQ$.

The balance of the elements of manpower position cost are described in the equations of the next 5 sections. Sections 5-8 cover the remaining elements necessary to estimate the Army manpower cost and Section 9 describes the transformation of this value into a position cost by the addition of the opportunity cost of unworked time.

5.0 MEDICAL BENEFITS

Under this title we gather the various medical benefits offered to the enlisted soldier and his dependents during his service. The economic model also considers post-service medical benefits: for example CHAMPUS coverage for dependents of retirees.

Medical costs consist of the sum of four items: 1) Civilian Health and Medical Program of the Uniformed Services (CHAMPUS); 2) medical and dental care in Army facilities; 3) care in nondefense facilities; and, 4) care in Veterans Administration facilities. In modeling each of these costs we combine financial data with utilization rates in calculating the cost of current medical care by MOS and pay grade.

The following discussion describes the cost elements, the available data, and a technical approach to modeling medical costs.

5.1 CHAMPUS

The Civilian Health and Medical Program of the Uniformed Services provides care in nondefense facilities to active duty dependents, retired personnel and their dependents, and dependents of deceased personnel. In FY83 the Army's total CHAMPUS obligation was $362,000,000.

To convert CHAMPUS costs to manpower position costs we first find the average cost per active Army dependent visit from the tables below. Next, we find the average annual cost of dependents

by taking the product of per-visit cost with the utilization rates (presented in Tables 5.3, 5.4 and 5.5). The final step is to distribute these costs to specific positions. We do this by determining the number of dependents per person filling each type of position from the JUMPSX/EMFX merged file.

To find the average cost of Active Army dependent inpatient and outpatient care we use the following tables provided by the Office of Civilian Health and Medical Program of the Uniformed Services (OCHAMPUS).* Table 5.1 shows the inpatient and outpatient care by category of CHAMPUS user in FY83.

Table 5.1. Inpatient and Outpatient Care by Army Recipient

CHAMPUS User Category	Inpatients	Outpatients
Dependents of Active Army	44,522	90,340
Dependents of Retired/Deceased	13,372	35,835
Retired Army	27,666	97,441
TOTAL	85,560	223,616
TOTAL($)	303,400,000	58,600,000

The average cost to CHAMPUS of inpatient and outpatient visits for all branches of the Armed Forces is shown in Table 5.2. Lack of significant variation in outpatient visit reflects facility charging practices for care delivered under CHAMPUS strictures.

* Office of Civilian Health and Medical Program of the Uniformed Services (OCHAMPUS), telephone communications, 1984.

Table 5.2. Average Cost to CHAMPUS per Medical Episode ($)

	Males		Females		All Patients	
AGE	Inpatient Admission	Outpatient Visit	Inpatient Admission	Outpatient Visit	Inpatient Admission	Outpatient Visit
<1	4,958	47.76	5,034	47.76	5,123	47.76
1 - 4	2,230	47.76	2,024	47.76	2,162	47.76
5 - 9	2,797	47.76	2,016	47.76	2,457	47.76
10-14	5,574	47.76	3,803	47.76	4,746	47.76
15-19	4,044	47.76	2,414	47.76	2,973	47.76
20-24	2,835	47.76	2,051	47.76	2,112	47.76
25-34	2,577	47.76	2,241	47.76	2,255	47.76
35-44	1,792	47.76	2,003	47.76	1,963	47.76
45-54	1,829	47.76	1,886	47.76	1,776	47.76
55-64	2,388	47.46	2,296	47.76	2,339	47.76
65>	2,908	47.76	3,308	47.76	3,124	47.76
TOTAL	2,666	47.76	2,910	47.76	2,476	47.76

The total Active Army Dependents portion of CHAMPUS--114,551,108--was derived by multiplying the number of recipients (44,522 inpatients & 90,340 outpatients) with the average cost obtained from combining the information from Tables 5.3 and 5.5.

Several additional data sets were produced for the modeling of CHAMPUS, all extracted from the JUMPSX/EMFX merge file. The average age by YOS, the proportion married by YOS, the average number of dependents by YOS, and the proportion female by YOS were collected by aggregating across other dimensions (MOS, pay grade, etc.). Also, the modeling required a life-expectancy table for active and post-service personnel: the table we used was supplied by the DMDC Office of the Actuary.*

* FY83 DOD Statistical Report on the Military Retirement System, RCS No. DDM (A) 1375, Office of The Actuary, Defense Manpower Data Center, Washington, 1984.

In a first step a table of average annual inpatient and outpatient costs per recipient is created in which recipients are disaggregated by age, gender and whether (a) a recipient is a dependent of an active Army soldier, (b) a dependent of a retired or deceased soldier, or (c) is a retired soldier. This table will not be properly scaled to reflect the CHAMPUS budget for inpatient and outpatient care, but later costs derived from this table are rescaled. Tables 5.3, 5.4 and 5.5 present utilization rates obtained from the 1978 National Health Survey.

Next, using force continuation rates and the life-expectancy table, we create from current inventory a table of eventual retirees disaggregated by age and current YOS. Each soldier currently in YOS L is counted in the retiree table with age A if he is expected to live to age A (given his current active status). Actually the life-expectancies are translated into probabilities for surviving another year, and the table is produced for each YOS L by propagating a simple recurrence relationship, starting with the probability he remains in service to retirement.

Third, we accumulate in a table the distribution of recipients by type (dependents of active Army, dependents of retired/deceased, retired Army), YOS of active soldier and recipient's age and sex. By active soldier's YOS is meant: for dependents of active Army, the soldier's YOS; for dependents of retired or deceased soldier, the YOS in which the currently active duty soldier is expected to retire or die; and, for the retired Army, the YOS in which retirement was taken.

Table 5.3. Number of Visits to the Physician Per Outpatient Per Year

Sex	All Ages	<17	17-24	25-44	45-64	65-74	>74
Male	4.0	4.2	3.0	3.4	4.7	5.5	6.4
Female	5.4	4.0	5.5	5.8	5.9	6.8	6.4
Both Sexes	4.8	4.1	4.3	4.7	5.3	6.2	6.4

Table 5.4. Number of Dental Visits Per Person Per Year

Sex	All Ages	<17	17-24	25-44	45-64	65-74	>74
Male	1.4	1.5	1.4	1.5	1.6	1.0	1.0
Female	1.7	1.8	1.7	1.8	1.9	1.4	1.1
Both Sexes	1.6	1.6	1.5	1.7	1.7	1.2	1.1

Table 5.5. Percent Distribution of Number of Hospital Episodes (Inpatient)

	Both Sexes				Males				Females			
Age	0	1	2	3	0	1	2	3	0	1	2	3
<17	94.7	4.7	0.5	0.2	94.4	4.9	0.5	0.2	95.0	4.4	0.5	0.2
17-24	89.4	9.3	1.1	0.3	93.8	5.5	0.5	0.2	85.2	12.8	1.6	0.4
25-34	87.6	10.9	1.2	0.3	93.3	5.8	0.7	0.2	82.1	15.8	1.7	0.3
35-44	90.3	8.1	1.2	0.4	92.7	6.0	0.9	0.4	88.1	10.0	1.5	0.4
45-64	87.9	9.3	2.0	0.8	88.2	9.2	1.8	0.8	87.6	9.5	2.1	0.8
65>	82.0	13.3	3.4	1.3	80.8	14.3	3.5	1.4	82.8	12.7	3.3	1.2
All	89.6	8.6	1.4	0.4	91.5	7.0	1.1	0.4	87.8	10.0	1.6	0.5

Fourth, the average annual inpatient and outpatient CHAMPUS costs are calculated separately for each type of recipient, active soldier YOS, and age and sex of recipient. The costs are totaled and rescaled using the actual CHAMPUS budget figures inflated to FY84 dollars.

Fifth, the average CHAMPUS cost for dependents of active duty soldiers, by YOS, is calculated, using the distribution of recipients by recipient type, YOS of active duty soldier, and recipients age and sex, calculated in step three, and taking the inner product with the cost table produced in step four.

Sixth, for retired soldiers and their dependents, using the same tables, calculate, by retirement YOS, the present value at retirement of the average CHAMPUS cost for retired soldiers and their dependents. The average is again obtained with the recipient distribution table; however this time a real discount factor is included so that the average will reflect its present value at retirement. Note that for retired soldiers and their dependents no cost will be included in the budget cost model. These costs will be included only in the economic cost model.

Seventh, continuing from step six, the annual level payment scheme is imputed as a means to fund this government obligation as the average soldier marches to retirement vestment. (See Section 5.7 for more details about how this is done.) We end up, for the economic model, with an additional vector of costs required in each active duty YOS to fund CHAMPUS payments for their retirement.

With these two YOS vectors of costs per soldier, while he is on active duty and subsequent to his retirement, we finally calculate for each MOS and pay grade, based on its YOS inventory distribution, a manpower cost for CHAMPUS. Note again that the budget model does not consider post-service medical costs.

5.2 MEDICAL AND DENTAL CARE IN ARMY FACILITIES

Our first problem in modeling the cost of medical and dental care in Army facilities was identifying appropriate cost figures to best represent marginal variable Army costs. Optimal cost figures do not include overhead such as fixed facilities costs and administrative costs. Once the appropriate cost figures were determined, we distributed the cost to each position in accordance with the age and sex characteristics of persons filling said position. Finally the utilization rates (see Tables 5.3, 5.4 and 5.5 above) were used to produce marginal annual medical costs for each position.

There are two breakdowns of the budget produced by the Office of the Director of Operation and Maintenance, Army (OMA) which can be used to estimate the marginal cost of care at defense facilities. The first is the OMA nonpersonnel budget costs for FY83:* however, the nonpersonnel costs include some overhead. The overhead included is from defense medical facilities which are not located at a military base. The majority of medical facilities are located at Army

* Justification of Estimates for Fiscal Year 1984, Operation and Maintenance, Army, Department of the Army, submitted to Congress February 1983. Also referred to as O&M Budget.

installations, and each installation pays for overhead expenses. When this is not the case, the medical facility pays for the costs of heating, lighting, etc. which is included in the OMA budget.

The second breakdown of the OMA budget--which avoids the problem with overhead--is the Army's cost of inpatient and outpatient care. The flaw with this data is that it does not include surgical costs, nor costs of special procedures such as radiology. However, the benefits of using this data are that administrative personnel costs are not included and it distinguishes between two services (inpatient and outpatient care) which have significantly different utilization rates and costs: the Army estimates the cost per inpatient bed-day to be almost ten times greater than outpatient costs in FY83.

The amounts for each of the two possible cost breakdowns prepared by the Office of Operation and Maintenance,* Army appear in Table 5.6.

Table 5.6. Cost of FY83 Care in Army Facilities (Dollars)

	Inpatient	Outpatient	Nonpersonnel
Medical Care in Regional Facilities:	45,631,000	35,466,000	128,548,000
Station Hospitals/ Medical Clinics:	54,849,000	69,045,000	168,267,000
Dental Activities:	51,223,000	3,579,000	14,545,000

* Correspondence with Army Office of Operation and Maintenance.

To determine the proportion of these medical costs which are attributable to each category of Army beneficiary we use data obtained from the Office of the Surgeon General* that appears in Tables 5.7 and 5.8.

Table 5.7. FY83 Average Daily Worldwide Workload

	Inpatients	Outpatients
Active Army*	2,240	23,762
AA Dependents	1,448	16,705
Retired Army	803	5,277
Dependents of Retired/Deceased	609	5,382
TOTAL	5,097	51,126

*Active Army includes Officers and Enlisted personnel.

Table 5.8. Total Bed-Days Worldwide in FY83

	Inpatients	Percent
Male Enlisted	734,118	85%
Female Enlisted	134,468	15%
TOTAL	868,586	100%

Note that the average daily care reported in Table 5.7 does not distinguish between care of officers and enlisted personnel. Personal contact with the staff in the Office of the Surgeon General disclosed that close to 93 percent of those Active Army individuals receiving care were enlisted personnel. Thus, average

* Correspondence with the Army Office of the Surgeon General.

daily enlisted inpatient care is 2,083 rather than 2,240. The daily inpatient workload for other categories of inpatients must be similarly adjusted. The annual workload must then be determined by multiplying the average daily workload by 365. This annual workload is then divided into the costs in Table 5.6 to determine the average cost per patient.

The marginal cost per dependent is computed in the same manner as was described for CHAMPUS. The marginal cost per active duty person is found by taking the average cost, AC, as the total cost divided by the average annual workload, AAW:

$$(5.1)\quad AC = TC/AAW\ .$$

Distinguish between the average cost for males and females by using the percentages in Table 5.8:

$$AC(f) = .15 \cdot AC$$
$$AC(m) = .85 \cdot AC$$

The marginal cost of each sex and age group is then obtained from considering the sex and age specific utilization rates:

$$(5.2)\quad MC(age,sex) = AC(sex) \cdot URATE(age,sex)\ .$$

The number of individuals by age and sex in MOS i and pay grade j is denoted as $N_{ij}(age,sex)$. The marginal cost is then the following:

$$(5.3)\quad MC_{ij} = \sum_{age,sex} MC(age,sex) \cdot N_{ij}(age,sex)\ .$$

5.3 ACTIVE ARMY USE OF NONDEFENSE FACILITIES

The marginal cost of nondefense facilities is determined in a manner similar to that used to estimate Army facilities costs as discussed above. The Active Army nondefense facilities medical cost is $22,087,000. Again, we assume that ninety three (93) percent of this amount is for enlisted personnel with eighty five (85) percent received by males and fifteen (15) percent by females. The marginal cost is determined with the utilization rates and the YOS age and sex distributions presented above.

5.4 VETERAN'S BENEFITS

Cost data from the Veterans Administration (VA) were nowhere in a form useable for a marginal cost analysis, and this cost component was ignored in the first stage of model development. While it may be argued that true marginal VA costs should be very small, in another phase of model development this supposition will need confirmation.

6.0 ACCESSION COSTS

The accession cost element presents the combined costs of recruiting, equipping and training a soldier in preparation for his first duty station. We include marginal costs for advertising and recruiting, accession Permanent Change of Station (PCS), enlistment bonuses, initial equipping, and all initial training required for performance of the first duty assignment. Not only basic and initial entry training (IET), but also any advanced individual training (AIT) necessary for MOS skill level one, are included as accession training.* Thus, under this heading--and not under "Advanced Training"--do we place advanced individual training. In contrast, the next manpower cost category, advanced training, carries no portion of skill level one training; advanced training presents the cost of all subsequent skill progression training.

Most sources of cost data for the various elements of both recruitment and training provide average rather than marginal costs. Obtaining the marginal advertising cost was particularly difficult, as the reader will appreciate (see below). In most instances we have had to rely on studies undertaken elsewhere, with other aims than to estimate marginal costs. For a couple of cost items we were obliged to judge no portion of the cost to be marginal, not on a

* In the interest of brevity, however, we discuss the derivation of the cost of accession training and the issues surrounding that derivation in the next section because the discussion is relevant to all training.

matter of evident data, but because no data was available, and the judgement appeared reasonable.

6.1 AMORTIZATION OF ACCESSION COSTS

Modeling differences between the economic and budget cost models resulted mainly from the way in which marginal costs were allocated to manpower positions. For the economic model, the cost to fill an additional 11B20 position will include the cost of providing sufficient training to fulfill such duties. And, in part, this training will have been formal 11B accession training, received over two or three years ago. In what measure has this previous training been superseded by on-the-job experience? And in what measure has it been degraded by lack of recent application? Both these questions are traditionally posed--using the language of human capital theory--in terms of the useful life of the training provided. This issue is treated more fully in the next section.

While it would require a sizeable effort, to investigate the useful life of accession training directly, MOS by MOS, would be practicable and warranted research--given the size of this cost item. We have been unable, in this first edition, to do this. As a proxy, we have taken the useful life to be the length of the enlistment term purchased--by the enlistment bonus and training package--assuming reenlistees soon find themselves placed in leadership roles.

The useful life of some accession cost items is rather easy to ascertain. Recruiting efforts, advertising, accession PCS and en-

listment bonuses serve the length of the enlistment contract bought. Initial equipping also lasts, on average, one enlistment term.

For the budget cost model, the useful life of training provided is not an issue. Costs for training, as for anything else, are allocated as, and in the manner in which, they are incurred. If training is provided to E-2 soldiers then the entire cost is reflected in the budget cost of an E-2. [Note that in the budget model the pay grade E-2 includes both the E-1 and E-2 private soldier ranks.]

In summary, our model is as follows. All accession costs in the economic model are amortized over the service years of the first enlistment term, while in the budget cost model all costs are assigned as incurred.

Amortization was effected by constructing an extract from the JUMPSX/EMFX merge file (described in Section 4) of counts of those in their first enlistment term, disaggregated by MOS and pay grade. Costs were spread over first term service years by taking the sum of persons in their first term and dividing total costs by this sum to yield a cost per year in service. This cost was then assigned to each pay grade in proportion to the relative number of first termers in that pay grade.

We shall now study the derivation of each each cost item included under this cost category. Derivation of the cost of accession training is treated in Section 7.

6.2 RECRUITMENT

The elements of recruiting cost included in the model are:

- Advertising
- Recruiter Pay
- Delayed Entry Program
- Applicants' Meals, Travel and Lodging
- Hometown Recruiter Assistance Program (HRAP)
- Tour Exhibits
- Total Army Involvement in Recruitment
- Tests and Examinations at Military Enlistment Processing Stations
- Enlistment Bonuses
- Initial Equipping

Each element is discussed in detail in the following subsections.

Advertising

Advertising costs for the Active Army are primarily costs of publications and direct mailings addressed to high school students and commercial advertising oriented to high school graduates and students. The cost of advertising does not vary by each applicant or recruit, but advertising does have a direct correlation with the number of recruits.

There are three possible means of modeling advertising costs. The first is to use current advertising costs and extract the regression coefficients from the analysis by Vincent Carroll* of the Wharton School who tested the effects of local, national and joint services advertising on Navy enlistments. He found that local and joint advertising have a significant effect on enlistments, but national advertising has had very little direct payoff. One could

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* Carroll, V., "Navy Enlistment Marketing Experiment," Marketing Science, Vol. 4, No. 4, Fall 1985.

use these Navy coefficients with the Army budget amounts to determine current marginal costs. A major problem with this procedure is that the Navy's advertising expenditures are far less than the Army's. If there were not a linear relationship between advertising expenditures and the number of enlistments, this methodology would be biased. For example, if there were diminishing marginal returns to advertising, the Navy coefficients would overestimate the return from the Army's greater expenditures.

Second, the advertising firm of N. W. Ayer has studied the aggregate effects of advertising on the number of enlistments. By using their regression coefficients and the current Army budget amounts of total Army expenditures, the current productivity of advertising expenditures can be estimated. Since this study was recently performed for the Army this would be preferable to the first approach.

A third source of econometric work is from Daula and Smith.* They use the number of high quality recruits as the dependent variable. The work is current and will be annually updated. It shows the relationship between advertising expenditures and the targeted group of high school graduates. Because there is no additional cost of low quality recruits, the marginal cost of advertising for non-high school graduates categories is zero. This study is theoretically accurate in its choice of the dependent variable and it will allow annual updating of the manpower cost model.

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* Daula, T. and D. Smith, "Estimating Enlistment Models for the Enlisted Army," in Army Manpower Economics, edited by Dr. C. Gilroy, Boulder, 1985.

To implement this last approach we derived from the JUMPSX/EMFX data the distribution of accessions in each MOS by demographic characteristic. In particular, the proportion of high school graduates in each MOS was empirically obtained and applied to the marginal cost of recruiting a high school graduate through advertising to yield the MOS manpower advertising cost per recruit.

Recruiter Manpower Cost

The marginal cost of recruiters is determined from two sources of data. First, the recruiter's position cost is estimated in advance. Since recruiters have completed a first term of service, there is no problem in deriving their position cost prior to deriving accession costs in general. Second, the recruiter enlistment elasticity from Dertouzos is applied to provide a marginal cost methodology.*

As can be seen from Table 6.1, there has been a significant shift to high quality accessions. When modeling recruiter behavior, Dertouzos recognizes the role of quotas in obtaining these more costly high quality recruits.

Dertouzos concludes that high quality categories are four times as costly to recruit as lower quality enlistments. This implies that once the recruiter's quota is met, there are few incentives to exceed the quota. Currently the Army awards 16 points for each high quality and 10 points for each low quality recruit in excess of the

* Dertouzos, J., "Recruiter Incentives and Enlistment Supply," R-3065-MIL, Rand, Santa Monica 1985.

Table 6.1. Distribution of Non-Prior Service (NPS) Accessions

EDUCATION CATEGORY	MENTAL CATEGORY	FY81 TOTAL	FY81 %	FY83 TOTAL	FY83 %
HSDG M	I-IIIA	31916	27.1	55340	41.7
	IIIB	16612	14.1	28472	21.5
	IV	29001	24.6	15914	12.0
	TOTAL	77529	65.7	99726	75.2
NHSDG M	I-IIIA	14292	6.7	13591	10.2
	IIIB	11655	10.1	2865	2.2
	IV	43430	1.9	33	0.0
	TOTAL	69377	18.7	16215	12.4
TOTAL NPS	(M)	99613	84.5	116215	87.6
HSDG F	I-IIIA	6822	5.8	12599	9.5
	IIIB	5239	4.4	3899	2.9
	IV	5140	4.4	18	0.0
	TOTAL	17201	14.6	16516	12.4
NHSDG F	I-IIIA	501	0.2	0	0.0
	IIIB	555	0.5	0	0.0
	IV	45	0.1	0	0.0
	TOTAL	1101	0.9	0	0.0
TOTAL NPS	(F)	18302	15.5	16516	12.4
TOTAL NPS	M+F	158140		120353	

quota. However, if the tradeoff is one to four, so the recruiter can obtain four low quality recruits for a single high quality individual, then he has an incentive to do so from the additional points earned. On the margin, the recruiter has an incentive to emphasize the low category.

Recognizing the role of recruiter incentives and quotas, the regression equation includes quota variables. The dependent variable is high quality enlistments and the independent variables in-

clude low quality enlistments, number of recruiters, and a quota variable. For monthly data in 1980 the elasticity of high quality recruits with respect to recruiters was estimated at .842. Thus, a ten percent increase in the number of recruiters will cause a rise of 8.42 percent of high quality recruits. The elasticity of low quality recruits is -.393 which indicates that a ten percent rise in low quality recruits leads to a four percent decrease in high quality enlistments.

The use of these elasticities and the manpower cost of recruiters determines the marginal recruiter cost for the economic cost model. The marginal economic cost of high quality recruits is 8.42 percent of the recruiter position cost. The corresponding cost for low quality recruits is a proportion of the marginal manpower cost of high quality recruits.

Delayed Entry Program

The Delayed Entry Program (DEP) allows an individual to postpone participation in the Army up to 365 days after signing his contract. As a budget item, DEP includes all costs of keeping the contracted individual informed about the Army until he eventually enters active duty. The budget for DEP in FY83 is $312,000.* An additional cost of DEP in 1984 (discontinued from January, 1985) is the higher starting pay of an individual when he begins his enlistment, as compared to an individual who joins the active Army right

* O&M Budget.

after signing a contract. There is no particular group of recruits who benefit from DEP so this cost should be spread over the total number of accessions (145,337 in FY83 or less than a penny per accession). Compared to USAREC's entire recruiting budget of $180,349,800 the cost is insignificant and will not be included in the model.

Applicants' Meals, Travel and Lodging

This reflects the cost of transporting the applicants to the Military Entrance Processing Stations and their subsistence and lodging during the examination process. This cost is incurred with each recruit and is therefore considered a marginal cost. The total budgeted amount* is divided by the number of accessions and included as a per capita cost in both models.

Hometown Recruiter Assistance Program (HRAP)

HRAP provides payment for travel and per diem expenses incurred by active Army personnel who are recruiter aides. The budget amount covers travel cost from permanent duty station to temporary duty and return, and the additional travel charges that are incurred by soldiers on HRAP during permanent change of station (PCS) moves, where the cost exceeds the standard PCS charges. Also included are reimbursement expenses excluding rental cars and overseas travel.

The budget amount of HRAP is distributed to accessions of mental categories I-IIIA and high school graduates because the purpose

* Military Enlistment Processing Command, correspondence, 1984.

of this program is to attract this quality of person. Hometown Recruiter Aides are typically E-1s and E-2s. To model the personnel costs of HRAP requires the time spent by rank of aides in recruitment activities. As this information is not readily available, and the cost will not significantly alter the marginal cost per recruit, the personnel cost of HRAP is not included in the cost models.

Tour Exhibits

The costs of tour exhibits ($1,054,000 in FY83) includes TDY travel and per diem for personnel on the exhibit teams, as well as all other exhibit support costs in conjunction with touring exhibits. This serves a similar purpose to HRAP and is handled similarly, with nonpersonnel costs alone included.*

Total Army Involvement in Recruitment (TAIR)

TAIR provides the recruit with exposure to a wide range of performances and demonstrations by non-recruiter active Army personnel. Included are promotional appearances at activities such as parades, half time shows, fairs and similar events. Military Occupational Skill clinics, demonstrations, sports clinics, and Army exhibits and displays are given by prominent Army speakers to target audiences.

The cost of TAIR is the travel and per diem expense of sending Army personnel to TAIR events. Also included is transportation costs of prospective enlistees to Army installations.

The TAIR budget costs, obtained from USAREC,* are included in both models, distributed equally to each accession.

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* O&M Budget.
** U.S. Army Recruiting Command, Correspondence, 1984.

Tests and Examinations at Military Enlistment Processing Stations

Mental testing and physical examination of applicants to the armed forces is carried out at Examining and Entrance Stations of the Military Enlistment Processing Command. The Army's share of operating Military Enlistment Processing Stations is based on the number of tests given to Army recruits. The unit cost of examinations are given in the following table and are considered marginal (and hence included) since they are directly correlated to the number of Army recruits.

Table 6.2. Cost per Exam and Number of Exams in FY83*

EXAM	COST	NUMBER	TOTAL COST
Medical	$25.37	623,745	$15,824,410
Aptitude	6.64	949,029	6,301,553
Institutional	2.89	1,034,595	2,989,980
TOTAL			$25,115,943

* Military Enlistment Processing Command, correspondence, 1984.

Enlistment Bonuses

Enlistment bonuses are given to desirable recruits in hard-to-fill military occupational specialties. High school diploma graduates can receive from $1,500 to $8,000* for a contract of up to four years. Enlistment bonuses are a major recruiting cost which

* Perspectives on the Effectiveness of Service Enlisted Bonus Programs, General Accounting Office, Washington, 1982, p.3. The $8,000 bonus is only payable to enlistees signing for a 4 year term, $5,000 of which is paid upon successful completion of training and the remainder in $1,000 increments on the enlistment anniversary date.

can be attributed directly to an individual service member and thus are a marginal cost.

Enlistment bonus payments by military occupational specialty and dollar amount for fiscal year 1983 (as shown in Table 6.3) were received from the Planning, Analysis and Evaluation branch at the U.S. Army Recruiting Command.* Modeling the distribution of the enlistment bonus budget was therefore unnecessary.

Initial Equipping

The issuance of uniforms is an expense identified with each accession. The rate of $560.52 per male and $672.98 per female, as listed in the MP-A Budget, is attributed in accordance with the MOS gender distribution of accessions.

6.3 ACCESSION PERMANENT CHANGE OF STATION (PCS)

Accession PCS includes travel to/from short term training stations--such as reception--if they precede travel to the enlistee's permanent duty station or training school. Also covered are permanent change of Station Movements of enlistees, prior service personnel and recalled enlisted reservists to first permanent duty station or training school of twenty weeks or more in duration.

In FY84 the budget estimate of accession PCS was $164,864,000.** This cost is incurred on a per accession basis and are included on a per accession basis.

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* U.S. Army Recruiting Command, correspondence, 1984.
** MP-A Budget.

Table 6.3. Enlistment Bonus Dollar Amounts

MOS	TOTAL NUMBER	1500	2000	2500	3000	3500	4000	4500	5000	8000*	TOTAL $'000
05B	478			478							1195
05C	1075				1075						3225
05D	171						77	94			731
05G	79				79						237
05H	685						3		382	300	4280
05K	238					161	77				872
11X	7447						2		5714	1731	40695
12B	808					808					2828
12E	112					104	8				396
12F	20	20									30
13B	2849						2		2314	533	15789
13C	46			46							115
13E	384						1		353	30	2006
13F	676								509	167	3866
13M	43					43					151
13R	60			60							150
15D	346					346					1211
15E	543							3	307	233	3390
16C	9			9							23
16D	71			28	43						199
16E	84			68	16						218
16J	27			5	22						79
16S	223			209	14						565
17B	24				24						72
17C	22			22							55
17K	173			107	66						466
19D	1017						44		773	200	5621
19E	1837								1835	2	9191
19K	307								207	100	1825
21G	41			41							103
32D	225				225						675
43E	25			25							63
45D	42			42							105
45N	42			42							105
54E	353			353							883
55D	19				19						57
63N	133		133								266
63T	540		47	493							1327
72E	545		545								1090
82B	6			6							15
82C	128	128									192
82D	2			2							5
93H	142				22				113	7	684
93J	138				18				93	27	732
96C	108							31			355
98C	496							496			1984
98G	356				155	143	13	45			1043
98J	3					3					9

*The $3,000, over the $5,000 paid initially, discounted at the government's real discount rate of 10%, represents a real cost of $2,582.60.

Source: U.S. Army Recruiting Command

7.0 TRAINING COSTS

Under this title we cover the elements of training cost entered in the accession cost category--initial entry and advanced individual training--and those entered as advanced training costs. Before we detail the construction of marginal training costs we discuss how these costs are distributed to the service years in which the skill acquired is used.

7.1 USEFUL TRAINING LIFE

Determining the useful life of training for the economic cost model inevitably introduces some measure of judgement and arbitrariness. Human capital does not depreciate if the skill in question is continuously used; rather it falls into disuse either from the demand for other skills, or as it is superseded by new skills obtained on-the-job or through advanced training.

One option, of course, is to claim that the useful life of initial training lasts as long as the soldier remains in the Army. This leads to the rather unsatisfactory result of having identical accession training costs for all grades. A similar proposal, that the useful life extends the duration of service in the soldier's initial MOS, leads to rather the same unintuitive level grade costs. Whether a Staff Sergeant is still able to perform duties requiring the training he underwent upon accession is not the question. The question is rather whether the duties he performs daily in his advanced rank actually use that training or rather, skills obtained since then.

Gary Becker discusses the cost of specific and general training in his book, Human Capital.* There he suggests there is an equality relating employee wages, training costs, turnover rates, rates of return and pay back period. Following Butler,** we could assume a ten percent rate of return for government enterprises and solve the relationship for the pay-back period (interpreted as the intended useful life of the training). Note that in interpreting the level of investment made in training, the discrepancy between private sector and military wages should be interpreted as that part of training paid for by the soldier.

As noted in the preceding section, we have assumed that the useful life of Accession Training is the soldier's first term. Subsequent training is amortized over the paygrade in which it is received. Note that both these schemes are preliminary, to be addressed in greater depth in future editions of the models.

7.2 MODELING TRAINING COST

A data set was constructed from two separate Army data bases to model the cost of training. The Army Training Requirements and Resources System (ATRRS) maintains for each course of training a record (cited earlier) of each class of instruction given, the class start and end dates, and the class input and numbers graduating. The last two are disaggregated by a component code from which we

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* Becker, G., Human Capital, National Bureau of Economic Research, New York, 1975.

** Butler, R., "Imputation of a Sailor's Marginal Product: An Application of the Theory of Human Capital," RD-126, The Assessment Group, Santa Monica, 1982.

could distinguish enlisted from commissioned and initial entry from advanced trainees.

The second data base is a collection of cost analysis reports provided by each Training and Doctrine Command (TRADOC) school. These reports (cited earlier), known as ATRM-159 (Army Training Resource Management) course cost analyses, are collected and analyzed by TRADOC-DCS Resource Management, Resource and Economic Analysis Office. Their primary purpose is to furnish the Comptroller of the Army costs associated with individual training for update of the Force Cost Information System (FCIS) and the Soldier Cost Information System (SCIS).

The derivation of MOS training costs in the FCIS and SCIS was examined for their possible use in the manpower cost models. Their methodology was found to be inadequate as the vintage of their training course data was 1978. A match between ATRM-159 FY84 reports and their training course data left more than half of the ATRM-159 reports unmatched. Costs of unmatched courses were being inflated from FY79 levels, rather than being revised. Although the FCIS and SCIS have been discontinued, it is imperative that the ATRM-159 reports continue to be produced.

The TRADOC ATRM-159 course cost reports do not cover all courses provided to the Active Army; there are in all over ten training commands. However, TRADOC provides the majority of courses and, together with DARCOM and the U.S. Army Academy of the Health Sciences, over ninety five percent of the enlisted accession costs are accounted for. The Academy of the Health Sciences annually issues a report very similar to the TRADOC ATRM-159 based upon the same pric-

ing methodology. DARCOM does not issue course cost analyses and further work will be required to obtain their course costs. In terms of student load, TRADOC and the Academy of the Health Sciences provide over ninety seven percent of Army enlisted training.

The ATTRS data vintage was FY83; the ATRM-159 reports covered FY82 but were expressed in FY84 dollars. ATRM-159 was also available from the U.S. Army Management Systems Support Agency as a computer print file.* The data set constructed from the match-merge of ATRRS and ATRM-159 contained for each course of training provided in FY83 a record of the leader level intended of persons attending the course, the number starting the course, the number graduating, the length of the course, and the variable per-graduate course cost, where a match was found. The ATRRS maintains a file containing the MOS for which each course was designed.** This file was also match-merged to add an MOS identifier field.

The course cost analyses provide an economically sound distinction between fixed and variable costs. They include an element for all pay and allowances the student receives during training. For our marginal costing approach only the variable costs were used; also, student pay and allowances were removed to avoid double counting. The resulting course costs were directly used in the budget model. In the economic model we added a personnel cost derived as the sum of pay and allowances, benefits, retirement and VEAP.

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* Course Cost Analysis, ATRM-159, Computer File, TRADOC, DCRM, Ft. Monroe, 1984.

** ATRRS Course List, Computer File, Army DCS Personnel, Training Requirements Office, Washington, 1984.

7.2.1 Accession Training

As discussed in the preceding section, the cost of initial entry training is included in the accession cost element. Except for amortization, however, this cost is estimated in the same way as the cost for advanced training.

Table 7.1 provides a typical example of an ATRM-159 report. The course in question, 102-33S10, is the AIT course provided to MOS

Table 7.1. ATRM-159 Cost Analysis for Course 102-33S10

F2 — RCS ATRM-159(R1)

FY 1982 COST PER GRADUATE (FY 84 $)

COURSE TITLE EW/INTERCEPT EQUIP RPR (34.8 WEEKS)
(292.0 NORM GRAD)

COURSE NUMBER/MOS 102-33S10

DIRECT COSTS	OMA	MPA	PA	FMMA
1. DIRECT MISSION				
A. INSTRUCTIONAL DEPT	5,446	5,414		
B. FLYING HOUR				
C. OTHER	5,857	6,427		
D. SUBTOTAL	11,303	11,841		
2. TROOP SUPPORT				
A. P8				
B. P2/3				
3. AMMUNITION				
4. EQUIP ITEM DEPR			3,872	
5. STUDENT PAY & ALWS				
A. OFFICER ( )				
B. ENLISTED (E-1)		8,765		
6. TRAVEL PAY TO COURSE		127		
7. PER DIEM AT COURSE				
8. TOTAL DIRECT COSTS	11,303	20,733	3,872	
INDIRECT COSTS				
9. BASE OPERATIONS	17,494	4,633		
10. SUPPORT COSTS				
A. TRAINING AIDS	493	194		
C. OTHER	209	253		1,889
11. TOTAL INDIRECT COSTS	18,196	5,080		1,889
12. TOTAL DIRECT & INDIRECT	29,499	25,813	3,872	1,889
13. TOTAL COST PER GRADUATE $	61,073			
FIXED & VARIABLE COSTS				
14. DIRECT MISSION				
A. FIXED	9,382	9,236		
B. VARIABLE	1,921	2,605		
15. TOTAL DIRECT & INDIRECT				
A. FIXED	19,026	12,437	3,872	1,889
B. VARIABLE	10,473	13,376		

33S, EW/Intercept Equipment Repairers, prior to their first assignment to a unit. The length of the course is 34 weeks and 4 days. The number of graduates (n.b., not average on board) was 292 in FY82. The total cost per graduate is reported as $61,073. However the total cost does not represent the marginal cost per graduate, which we assemble from the report as indicated in Table 7.2. Only ATRM-159 items 3., 6., 7., and 14. are included; to these we add, for the economic model, an opportunity cost for time lost from duty.

Table 7.2. Marginal Training Costs

LENGTH OF COURSE	= 34.8 WEEKS		
ATRM-159 COSTS			
	OMA	MPA	PA
3. AMMUNITION			
6. TRAVEL PAY TO COURSE		127	
7. PER DIEM AT COURSE			
14. DIRECT MISSION			
B. VARIABLE	1,921	2,605	
COSTS FROM ATRM-159	$ 4,653		
Marginal Budget Course Cost			$ 4,653
Economic Cost of Lost Product*			6,130
Marginal Economic Course Cost			$10,783

*Annual Economic Personnel Cost = $9,195, as derived from the AMCOS model. It is the sum of: Pays, Allowances, Benefits, V.E.A.P. and Retirement Costs $9,195·(34.8/52) = $6,130.

From the point of view of the economic model, the expenditure of these resources while training a soldier is conceived of as the

Army making a human capital investment whose returns are to be recaptured in the first tour. In the above example, for an enlistment term of four years, the period of amortization will be three years and sixteen weeks. The amortized course cost used in the economic model would be $3,261.15. The budget cost model will ascribe $4,653 to the combined E-1/2 grade of the model.

7.2.2 Advanced Training

Advanced Individual Training required for the execution of a soldier's first duty station is not entered here, but above, under the Accession cost category. Here we place the cost of all subsequent training and associated PCS costs. An average is assessed for each manpower position type as defined by MOS and paygrade. No amortization is performed.

DLI course costs were obtained, but because no information was available to distribute them to MOSs, they were not included. In subsequent years we propose to model their distribution from a file containing individual PCS moves. Fully described in Section 9, this file also maintains the country to, or from which, the moves are made and MOS as well as paygrade information.

The lost opportunity cost was calculated as the manpower cost of the soldier, before receiving the training. This appears reasonable from the following argument. The cost of the lost opportunity--included in the economic model--amounting from lost duty while in training, cannot be higher than the manpower cost, since the Army can obtain the same product from another soldier trained to the

appropriate level--and hence costing the same. On the other hand, if the lost opportunity cost were lower than the soldier's cost then the Army would be paying more for its product than the value it places on it.

The extent of enlisted advanced training provided by the Army is not completely captured with this methodology: in particular two types of training are missed. The first is Non-Commissioned Officer (NCO) leadership training provided locally at the division level. Classes are interwoven with the general work schedule of the day, undertaken as extra duty and require little redirection of resources. Thus, no lost opportunity cost is incurred, and there is very little direct cost. Costs for this kind of training are not included in the manpower cost models.

The second is training supplied outside the continental United States (CONUS), the majority of which is in Europe. Most training provided outside CONUS is of the NCO leadership type and provided at the local division level.* Its cost is also not included in the cost models.

The advanced training cost element also includes a cost for training PCS (Permanent Change of Station). The modeling for this element is identical to that of rotation costs and is discussed in Section 9.

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* Contact with the Office of DCS Resource Management, Heidelberg, FRG confirmed that over 90% of training in Europe was NCO training at the division level. We were unable to gather the data required to model the remaining training in the first phase of model development.

8.0 RETIREMENT COSTS

The retirement cost category is calculated only for the economic cost model. For FY84 there was no Army budget item for retirement. However, as of October 1984, there is a Department of Defense (DOD) retirement budget line item; future enlisted budget models will present a retirement cost component, calculated by the accrual accounting method.*

In modeling (non-disability) retirement costs, a rationale is needed to allocate the cost of retirement to the soldier's active service years. J. Berterman presents a number of more or less appropriate methods,** among which we shall examine the two most appropriate for the Army manpower position models: level funding obligations and funding obligations in proportion to base pay.

According to Berterman, once a soldier becomes vested, the annual marginal cost is just the change, over the course of the year, in the present value of his future retirement payments, to begin upon his eventual retirement. Let us observe that, if a soldier remains in service after he has been vested, the present value of his retirement benefits may increase or decrease. While the payments will increase in size if he remains in service for an

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* See "Valuation of the Military Retirement System," Defense Manpower Data Center, Department of the Actuary, Washington, 1983.

** Berterman, J., "Retirement Costs," Appendix D in Naval Manpower Costs and Cost Models: an Evaluative Study, ASC R-119, Administrative Sciences Corporation, Alexandria, 1978.

additional year, the present value may decrease because his life expectancy will decrease, and with it, the length of his retirement stream. Consequently, if we follow Berterman, a negative retirement cost will be applied to later years of service. This is inconsistent with our model of the accrual of benefits for a soldier's service.

Berterman's model assumes that, upon vesting--acquiring twenty years of active service--the government has built up, through some funding procedure, the required present value of the soldier's retirement benefit. Subsequently, it is so modeled, the retirement cost is the additional sum that must be placed in the fund; or removed from it, if the present value decreases. This model of the accrual of retirement obligations artificially separates the cost of service for years before and after vesting, and uses different cost approaches for each.

Our view differs. The government possesses knowledge of the likelihood of a soldier's retirement vesting, and the distribution of the time he will remain in service thereafter. Our model calculates a retirement funding schedule for each vested year of retirement (LOSs 20 to 30). Each schedule specifies the government's retirement obligation in each active duty service year, prior to the specific retirement LOS. Notably, for later years of retirement, the schedules decrease. Our model identifies, for each position--using the underlying position LOS distribution--from continuation rates, the proportion destined to be vested, and from historical

retirement data,* the distribution of their retirement LOSs. And, together with respective funding schedules, produces a weighted average retirement obligation for each service year.

The question still remains as to which funding schedule to use. The choice is entirely arbitrary. Two extremes are: 1) to fund entirely when the soldier eventually retires and 2) to fund entirely on recruitment. Neither of these "schedules" places a cost on intermediate service years. Two choices we have considered are: 1) level funding and 2) funding in proportion to base pay.

Level funding, our choice for the manpower position models, involves a level payment funding schedule. Similarly, funding in proportion to base pay uses a schedule in which yearly payments are proportional to base pay. While the latter is perhaps more appealing--many private and public sector fund their retirement schemes this way--it is considerably more difficult to calculate, since it involves the calculation of separate schedules for each possible career path, and identifying the proportion following each respective path. Berterman makes a comparison between the two funding schedules, which are valid, relative to our procedure, up to LOS 20.** The two schedules are quite similar, differing substantially in only two or three later LOSs.

The retirement cost element is the sum of four similar items of which retirement itself is by far the largest; the others are

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* "Report on the Military Retirement System," Office of the Actuary, Defense Manpower Data Center, Washington, 1983.

** Berterman, op. cit.

severance, disability and death payments. In the modeling of each of these there are two analytically separate steps.

Step one combines financial and actuarial methods in calculating, for those who will receive a time stream of payments, the cost incurred in each prior year of service. For example, in this step of the retirement calculation--on behalf of a member of the service who will retire in grade GR and YOS LR--we compute the annual level payment required to fund all his retirement payments.

While the first step computes and uses data that are service-wide, in the second step we take MOS inventories, CMF continuation rates and retirement distributions to produce an MOS-specific retirement cost. Thereby, it is arranged that every service-wide calculation--that would otherwise have to be repeated for each MOS--is preprocessed in the first step. Every calculation in the second step is unique, which is important since it is there that 360 MOS-specific retirement costs are computed.

In the second step, stochastic and statistical methods are used to estimate the main parameters of retirement cost. The former projects the relative proportion of persons who survive in the service to achieve vesting for retirement, while the latter forecasts (the relative distribution, for those who became vested, of) their final pay grades when they retire. The inner product of the vector of products of continuation rates to YOS twenty with the YOS inventory vector, provides the number of persons who eventually will retire. Such persons are distributed over final retirement grades to pre-

serve an empirically derived retirement distribution. This is done according to the principle that the persons of a certain paygrade with lower YOS will go further, to retire in a higher grade. [A study was conducted using a contrasting principle: that pay grade at retirement is independent of the individual's current LOS. The difference in result was under 2%, and the former principle was retained, as it simplifies computation, and possesses "intuitive appeal."]

The advantages of this "projection backwards" method--of using a future distribution to find present members' futures--over the "projection forwards" methods of taking promotion rates, expected times to promote and times in grade, amount to four:

1. Running time: Without a loss of accuracy, the computer model will run hundreds of times faster.

2. Accuracy in cost estimation: Since equal level payments are used, the grouping of YOS by final grade is all the "current" YOS precision required to assume the correct relative proportions of costs incurred by the relative distribution of retirements by grade. "Forward" methods cannot be controlled to achieve this future retirement distribution and proper weighting of costs.

3. Data collection: While retirement data are easily available (DMDC Loss File) even to the level of some skill specificity, promotion data are very hard to come by, costly to process and require many times more storage.

4. In general, promotion data only provide a mean promotion pattern per pay grade and reveal no fast or slow differences. Thus the qualitative notion of persons of a certain grade with relative YOS being on a faster promotion track than those with a higher YOS is lost. Our proposed method avoids the difficulty and preserves this notion in assigning lower YOS personnel to the higher grades of future retirement.

Both methods take a weighted cost average when taking into account the retirement YOS: there does not appear to be a way of predicting final YOS by current YOS or grade. We feel the only guidelines are the retirement patterns themselves. We found that the relative distributions of retirement by YOS for each grade were not CMF specific and, hence, this step was preprocessed, further reducing computation time.

This method provides retirement costs that do not vary so much by MOS as by grade. The reason is that the continuation rate--roughly 90% of the variance in which is explained by YOS--is the controlling variable in the computation. The result is MOS specific, however, because the MOSs themselves have different grade and YOS distributions. While the discount rate affects the amount of retirement cost, it is the YOS specificity of continuation rates that determines the relative costs between position types. Recall that the discount rate for evaluating present values to the government of alternative investments--here the present value of the cost of buying an additional year of service--is governed by the previously cited OMB Circular (A-76) and is set at 10%.

8.1 NON-DISABILITY RETIREMENT

STEP ONE:

Rules for retirement vesting require a total active federal military service of at least twenty years. On retiring from the service with grade GR and years of service (YOS) LR, our member will receive until his death, a monthly annuity of:

(8.1) $A(GR,LR) = \min[2.5\%LR, 75\%]BP(GR,LR)$,

where BP(GR,LR) was his highest average monthly base pay over any consecutive three year period before retirement. A simplification made by the model was to assume the last three years of service offered the highest three year average. Note that base pay depends not on a members total active federal military service (TAFMS) (for which he receives vestment for retirement), but rather in accordance with his total active federal service (TAFS), which may be longer than his TAFMS. Thus average base pay by service year and pay grade was derived from personnel files rather than from pay tables.

In addition to this annuity, his family will receive, upon the member's death) $3,750 to help pay for costs incurred by his death, the occurrence of which we calculate as a function of his age at retirement (another DMDC Loss Edit file data extract) and his expectation of life from tables for enlisted servicemen (published by the DMDC Office of the Actuary). Thus, the expected total number of monthly retirement payments the member receives is:

(8.2) $nl = 12 \cdot XL[Age(LR)]$.

nl = number of monthly retirement payments
Age(LR) = service-wide mean age at YOS LR
XL(A) = expectation of life at age A, in years

The present value at retirement of all future retirement payments, RTF(GR,LR), can be thought of as a sinking fund which would just pay the annuity and leave enough to pay the death gratuity and burial cost ($3,750) when the member dies.

$$(8.3)\quad RTF(GR,LR) = A/r + A/r^2 + \ldots + A/r^{n1} + B/r^{n1}$$
$$= A(r^{n1} - 1)/(r \cdot i) + B/r^{n1}$$

A = A(GR,LR)
B = $3,750
i = monthly government real discount rate = .833%
r = 1 + i

We accumulate the value of this sinking fund during the member's service years. Distribution of this sum is accomplished by attributing to each year of active service a level payment, the accumulation and growth of which, over the years, is just sufficient to provide the fund necessary to pay retirement annuities and the death gratuity. The size of such a level payment can be calculated as:

$$(8.4)\quad RTP(GR,LR) = 12i \cdot RTF(GR,LR)/(r^{n2} - 1) .$$
$$n2 = 12 \cdot LR$$

STEP TWO:

In step two the YOS inventory cells 1 to 30 in each position of grade G are grouped into retirement computation units (RCUs) G to 9 corresponding to the distribution of grades of retirees not less than G. Call this retirement distribution PRG(GR), so that:

$$\sum_{GR=G}^{9} PRG(GR) = 1 .$$

PRG(GR) for grade G is the probability, for someone in grade G who will retire, of so doing from grade GR.

Leaving the methods of the grouping until later, note that:

1) The number of persons from RCU(GR) who will retire will be:

(8.5) $NRCU(GR) = PRG(GR) \cdot contB$,

contB = total number of those in this position who will continue in the service until they are vested for retirement.

2) For each person in RCU(GR) that will retire, a yearly cost (to the position) should be assigned of size:

$$(8.6)\quad CRCU(GR) = \sum_{LR=a}^{30} RTP(GR,LR)PRL(GR,LR|GR) ,$$

a = Max[LRCU(GR),20]
RTP(GR,LR) = level payment calculated in step one
PRL(GR,LR|GR) = probability of retirement from {GR,LR}, given the event of retirement from grade GR, a service-wide data extract from the DMDC Loss Edit records*

where LRCU(GR) is the average YOS for RCU(GR).

3) The resulting manpower position cost:

$$(8.7)\quad RTC_{ij} = \sum_{GR=G}^{9} NRCU(GR)CRCU(GR)/N_{ij} ,$$

where N_{ij} is the current inventory of this position.

For a few RCUs, LRCU(GR) will exceed 20 and must be explicitly calculated; in other cases no calculation need be performed since the resulting manpower cost simplifies to:

$$(8.8)\quad RTC_{ij} = [contB/N_{ij}] \sum_{GR=G}^{9} PRG(GR)CRCU(GR) ,$$

* This calculation is best preprocessed along with other step one calculations as the final calculation, the results of which, CRCU(GR,LR) are provided in step two as a table "look-up" entered via a data file.

where CRCU(GR) is just a table "look-up." Consequently, the algorithm runs, in practice, in a very short time, amounting to about 40 multiplications and 10 additions for each position.

It remains now to demonstrate how (1) is achieved; i.e., how the number of persons from RCU(GR) who will retire, NRCU(GR), is set to PRG(GR)ContB. (See Equation 8.5.)

For each inventory cell of YOS L define as the number who will retire:

$$(8.9)\quad \text{cont}(L) = N_{ij}(L)\text{PCR}(L,19)\ ,$$

where $N_{ij}(L)$ = the position YOS inventory; and PCR(L,19) = the product of continuation rates from YOS L to YOS 19 (which is unity if L is greater than 19) and is exactly the probability of continuing in the service until vested for retirement. The total number in this MOS and pay grade that will retire is denoted by:

$$(8.10)\quad \text{contB} = \sum_{L=1}^{30} \text{cont}(L)\ .$$

Then let:

$$(8.11)\quad \text{Pcont}(L) = \text{cont}(L)/\text{contB}, \qquad \text{for each } L = 1,..,30.$$

To accomplish the grouping into RCUs, set initially: a variable, YOS, to 31, two accumulators to zero, and initialize (to G) the final grade of retirement variable, GR. Then repeatedly accumulate the Pcont(YOS), decrementing YOS by 1 each time, until the accumu-

lation exceeds PRG(GR): simultaneous with the accumulation of Pcont(YOS) is the accumulation of Pcont(YOS)·YOS. Then the accumulators are linearly adjusted by subtracting the fraction of excess accumulation and the adjustments are passed on to the accumulators as their initialization for the next RCU grouping. We calculate:

(8.12) LRCU(GR) = Accumulation of [YOS·Pcont(YOS)]/PRG(GR)

For the initialization of the next round, GR is set to GR-1, YOS is left unchanged and accumulations are initialized to the adjustment subtracted at the adjustment step of the previous round. This round of initialization, accumulation, adjustment and LRCU calculation is continued until LRCU(GR) is not more than 20 (which will happen usually at the first round for positions with grades less than 8). For the remaining position RCUs, it is unnecessary to calculate the LRCU, since LRCU only occurs in the calculation step (2) as max[20,LRCU(GR)]. (See Equation 8.6.) It can be seen that this method ensures that (1) is satisfied.

Note that since the accumulation is the core of the algorithm, the running time of the computer model is very fast, indeed taking between 3 and 5 seconds per MOS.* Since there are many MOSs, this is a very important advantage of modeling retirement this way.

8.2 SEVERANCE

Severance pay is a one-time expenditure, paid as a lump sum upon severance for disability. The size of the severance pay (SVP)

* This estimation of the algorithm's running time is based on using an IMS-8000, 8 bit, 4 MegaHertz micro-computer.

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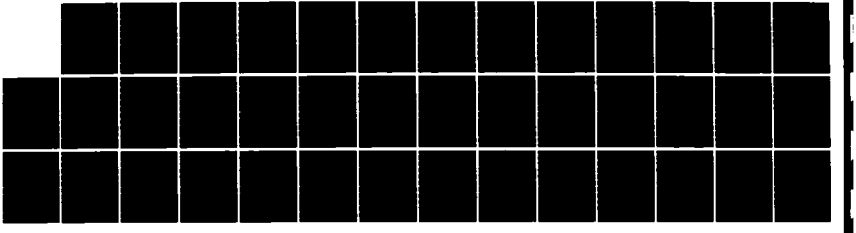

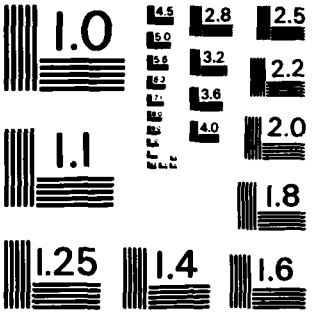

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is a multiple of the monthly base pay received prior to severance. The multiple is set to the number of six month periods (or part thereof) served in active military duty, up to a maximum of twenty-four.

STEP ONE:

Since we gather inventory data by YOS and not by month or any division of a year, we have to estimate the average sum paid to a severing member.* For a member with YOS L and grade G we do so by:

$$(8.13)\quad SVP(L) = \min\{24,[2L+(2L-1)]/2\}\cdot BP(G,L)$$
$$= \min(24,2L-0.5)\cdot BP(G,L)$$

where BP(G,L) is a TAFS-adjusted base pay as defined in the preceding section on retirement.

STEP TWO:

Experience has shown that in order to avoid estimation problems arising with small numbers, we cannot do better than to compress, in the first runs of the model, by MOS, the severance data collected from the DMDC Loss Edit tape. These data have been compressed into a service-wide table by grade and YOS of the probabilities of severance, PSV(G,L), during the current YOS. In which case, we estimate the severance cost to a position by:

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* We have decided that the small loss of accuracy is outweighed by the extra expense in processing data tapes to the level of six-month periods; this is in part justified by the fact that severance cost, being only a very small part of the total manpower cost, is dwarfed by even the relative size of retirement costs.

$$(8.17)\quad SVC_{ij} = \sum_{L=1}^{30} N_{ij}(L)PSV(j,L)SVP(j,L)/N_{ij} ,$$

where N_{ij} is the position inventory total, and $N_{ij}(L)$ is the (i,j) position inventory by YOS.

8.3 DISABILITY RETIREMENT

STEP ONE:

The first step is carried out along similar lines to non-disability retirement in calculating level payments required to fund the disability payments which could arise at a given point. The level payments are costed to each year prior to and inclusive of the year in which the disability occurs.

If a member retires disabled from grade G and YOS L with percentage disability D, then the monthly annuity he is entitled to is:

$$(8.15)\quad A1(G,L,D) = \min[\max(D,25\%L),75\%]BP(G,L) ,$$

where BP(G,L) is the final base pay received, drawn from personnel files.

Since a member's percentage disability is not reported along with notice of his retirement in the DMDC Loss edit tapes, we need to estimate the average annuity A(G,L) awarded. To do so we calculate:

1. The DAV(L) proportion of those in YOS L who are disabled and whose percentage disability exceeds 2.5% of their YOS; and
2. PDAV(L), for the same population proportion, their average percentage disability.

These are derived from tables published by the DMDC Office of the Actuary reporting each year classifying the occurrence of disability by grade, YOS and percentage disability.

Then the average annuity may be estimated by:

$$(8.16)\quad A(G,L) = DAV(L)A1[G,L,PDAV(L)] + [1-DAV(L)]A1(G,L,2.5\%L)$$

Following the relevant reasoning in the retirement section, the cost for a disability retirement to each of the prior years:

$$(8.17)\quad DSP(G,L) = 12[A(G,L)\cdot(r^{n1}-1)/r^{n1} + B\cdot i/r^{n1}]/(r^{n2}-1)$$

B = \$3,750, the sum of death gratuity and burial costs
n1 = 12 XL[age(L)] (see Equation 5.5)
n2 = 12 L
i = .833%, the monthly real discount rate
r = 1 + i

STEP TWO:

In step two the probability of becoming disabled in MOS M with grade G and YOS L, PDS(M,G,L), is estimated with precisely the same methods that are used for severance, and the same remarks directed to growing a data base apply here. Each year the number of persons expected to retire disabled from position (i,j), with YOS L, is $PDS(i,j,L)\ N_{ij}(L)$. For each such person a mean level payment of $DSP(j,L)/N_{ij}$ is included in the manpower cost. Thus we derive the position cost of disability retirement as:

$$(8.18)\quad DSC_{ij} = \sum_{L}\ \sum_{t\geq L} DSP(j,t)\cdot N\cdot PDS(i,j,t)/\sum_{L} N(i,j,L)\ ,$$

where N = N(i,j,t) is the specific (i,j) position inventory count of those with YOS t.

8.4 DEATH BENEFITS

STEP ONE:

Step one is again very similar. When an active force member dies, if he was married (or had dependents), his spouse receives $3,750 as a death gratuity and cost of burial--or he receives a military burial whence $750 is costed for burial-in-kind. In addition the government is responsible for providing a Dependents Indemnity Compensation, DIC as a monthly annuity, whose size depends on the final grade of the deceased member.

Thus the amount to be costed to each year of service prior to and inclusive of the married member's death is:

$$(8.19)\quad DTP1(G,L) = 12[DIC(G)\cdot(r^{n1}-1)/r^{n1} + B\cdot i]/(r^{n2}-1)$$

B = $3,750
n1 = 12 XL[Age(L)]
i = .833%, the government's discount rate for funds
r = 1 + i
n2 = 12L

where Age is the age of the spouse when our member has YOS(L) (estimated from the median difference in age of husband and wife available in the statistical abstracts of the United States)* and XL(a), her expectation of life at age a.

For members dying with no dependents, a burial-in-kind cost is attributable:

$$(8.20)\quad DTP2(G,L) = \$750\ .$$

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* Statistical Abstract of the United States, 1984, U.S. Department of Commerce, Bureau of the Census.

Thus we derive an average DTP weighted by M(L), the proportion of service members who have dependents:

$$(8.21)\quad DTP(G,L) = DTP1(G,L)M(L) + DTP2(G,L)[1-M(L)] \ .$$

STEP TWO:

In step two the probability of dying in MOS M with grade G and YOS L, PDT(M,G,L) is estimated in precisely the same fashion as was PSV and PDS in the sections dealing with severance and disability. Whence the manpower cost contribution due to death is:

$$(8.22)\quad DTC_{i,j} = \sum_{L} \sum_{t \geq L} DTP(j,t) \cdot N \cdot PDT(i,j,t) / \sum_{L} N(i,j,L) \ ,$$

where, as usual, N=N(i,j,t) is the inventory count.

8.5 TOTAL COST IN THE RETIREMENT ACCOUNT

The total cost of retirement is the sum of its elements, defined above. In summary, the economic cost of this category is:

$$(8.23)\quad C_{12ij} = RTC_{ij} + SVC_{ij} + DSC_{ij} + DTC_{ij} \ .$$

9.0 OTHER COST ELEMENTS AND TOTALS

Methods for estimating rotation and separation costs are discussed in this section. We also note that the cost of the VEAP program is not yet available. The exposition of the model concludes with a discussion of the computation of total cost for a soldier and for a position. Position cost, given in the economic model only, includes the cost of downtime.

9.1 ROTATION COSTS

The rotation cost category consists of Permanent Change of Station (PCS) move costs for Rotation, Operational and Organized Unit moves. Training, Accession and Separation PCS moves are modeled identically, but their costs are included under their respective manpower cost elements.

A Movement Designator Code, Current Duty (MDCCD) tape* was obtained from the Military Personnel Center (MILPERCEN) containing, for each soldier, a record of his MOS, pay grade, date of last PCS move, the Movement Designator Code (MDC) for the latest move and the area of current foreign service tour. The information was complete for the 1983 fiscal year.

A summary was extracted from the file, organized by MOS, pay grade and type move. Type move was constructed from the MDC according to whether the move was an accession, training, rotation, opera-

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* Movement Designator Code, Current Duty, Computer file, Army MILPERCEN (DAC-PSP-IQ), Washington, 1983.

tional cost, operational no-cost, organized unit or separation move. This summary was used to distribute budgets for PCS moves (published in the MP-A budget) to positions.

9.2 SEPARATION COSTS

There are three items in the manpower budget for separation: separation-PCS, separation pay and funds for the payment of unemployment benefits to honorably discharged ex-service members.

Separation PCS* is modeled as other PCS costs are, and the technique is presented in the Rotation cost section.

The separation pay budget** is allocated in accordance with the proportion of separators who will leave from each position type. The proportion of soldiers of a particular pay grade and MOS who separate in a year can be calculated from the appropriate CMF continuation rates and the MOS/pay grade YOS distribution.

Unemployment benefits are modeled to depend (linearly) upon the base pay. First, for the whole enlisted force the expected number of separators and the average separator base pay is calculated. The unemployment budget*** is divided first by the expected number of separators, yielding an average cost per separator, and then by the average base pay per separator, yielding the percentage of base pay the unemployment benefit offers to the ex-service member.

Then, for each position, the expected proportion separating in the coming year is multiplied by this percentage, and by the average

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* Department of the Army, MP-A Budget.
** ibid.
*** ibid.

base pay for the position, yielding the required unemployment manpower cost component.

Modeling the costs of unemployment benefits provides an example of the simplifying assumptions sometimes required. In order to derive MOS and paygrade position costs, we must model the relationship of a discharged soldier's unemployment benefit amount and his skill and grade.

The unemployment rate of pay the soldier receives depends upon the highest average base pay received during each of the four most recent quarters. The amount he receives depends, in addition, upon how long he remains unemployed. If we can estimate the average four quarter highest base pay rate, and the average length of unemployment for each MOS and grade, then the product will yield the average benefit dispensed, by MOS and grade, to a discharged soldier. Combining these amounts with annual rates of (honorable) discharge, by MOS and grade, would then provide the cost estimates desired.

In this example of unemployment benefits, we were unable to find any data on the length of unemployment as a function of either MOS or grade. Since the length of unemployment will depend upon a the marketability of a soldier's skill specialty, the simplifying assumption--which we were forced to make--that there is no relationship between length of unemployment and either MOS or grade, reduces the accuracy of the cost estimates thence derived.

The level of effort require to improve the accuracy of our estimates of unemployment benefits is not large, but was not avail-

able given our resources and order of priorities.* Correction would not appear to be of the utmost importance, but should be undertaken in future revisions of the models if resources are available.

It is possible to find data on the length of civilian unemployment spells by occupation. We could use these measures by applying the DoD code equating MOSs with civilian labor categories. Although there may be some differences in the relative effect of occupation on time between civilian jobs and that on time between exiting the service and finding a civilian job, the information would still permit us to distribute total Army costs for unemployment benefits among MOSs.

There are three possible types of civilian data for deriving occupation-specific unemployment durations. First, the Bureau of Labor Statistics regularly reports the duration of unemployment by six major occupational categories.** Although these are for total rather than insured unemployment, they may be adjusted since both the mean and percentage unemployed for different lengths of time are reported. A more difficult problem is that the data are not for completed unemployment spells.

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* To see this let us evaluate the consequent loss in accuracy. If the average period of unemployment were close to either the minimum (zero) or the maximum (six months) the loss in accuracy may have been small, were it not for the relationship between small skill communities and their skill marketability. In any case, the average evaluated to just under three and a half months. From another point of view, the loss in overall accuracy is small; unemployment costs are less than one percent of the total personnel costs.

** U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, "Unemployed Persons by Occupation, Industry, and Duration of Unemployment," monthly issues. Most recent as of this writing is August 1985, Table A-18, p. 25.

Studies of the effect of unemployment insurance (U.I.) on unemployment occasionally control for the effects of different occupations. These are a much better source of data. An excellent paper in this area by Kathleen Classen reports the effect of eight broad occupational groups on the duration of insured unemployment.* A similar study by Arlene Holen also used occupational control variables.** David Zulli has investigated the effects of U.I. on layoff unemployment and on the U.I. system's financial needs.***

A third possible source of data is the May Current Population Survey tapes. These tapes contain detailed occupational information as well as retrospective survey data on the number of weeks unemployed the previous year.

9.3 VEAP

This element has not been included in the manpower cost models as yet, due to delays acquiring Veterans Administration data.

9.4 SOLDIER AND POSITION COSTS

The marginal economic cost for a soldier is defined as the sum of all the cost elements covered in the previous sections:

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* Classen, Kathleen P., "The Effect of Unemployment Insurance on the Duration of Unemployment and Subsequent Earnings," Industrial and Labor Relations Review, July 1977, 4, 434-44.

** Holen, Arlene, "Unemployment Insurance Entitlement on Duration and Job Search Outcome," Industrial and Labor Relations Review, July 1977, 4, 445-50. Coefficient estimates on the eight occupational dummy variables were not published but may be obtained on request.

*** See Zulli, D., "Unemployment Insurance Financing in the 1970's: An Analysis of Illustrative State Experiences," Report for the National Commissions on Unemployment Compensation, May, 1980 and "Unemployment Insurance and Unemployment: Empirical Considerations, paper presented at the U.C.L.A. Theory Workshop, March 12, 1981.

$$(9.1)\quad C_{14ij} = C_{1ij} + C_{2ij} + \ldots + C_{13ij} .$$

The marginal budget cost for a soldier is the sum of only the first eleven items.

The distinction between soldier and position cost lies in the unit of work being costed. The soldier does not provide, typically, a full manyear* of labor. Indeed, he is entitled to 30 days leave a year, and time off for holidays. Transit between duty stations and status as a prisoner or patient also add to his unproductive time. However, the position he occupies in the force is intended to be productive throughout the year, and the loss of productivity from the soldier who otherwise fills the position represents an economic cost to the Army, a loss of real resources.** The economic cost of a position is thus the addition of a lost opportunity cost for unworked time added to the soldier cost.

From another point of view, since the lost productivity cost rate is identical to the personnel (soldier) cost rate, the position cost represents the cost of filling the position full time, if the Army were to do so. That is, the position cost is also the cost of obtaining a standard manyear of labor from that position.

One of the purposes of the Army Manpower Cost System (AMCOS) is to allow managers to perform cost comparisons, not only between cap-

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* The manyear referred to here is the standard manyear of 260 mandays which translates to a 5 day week for 52 weeks a year.

** The filling of unmanned positions by the first available soldier is an Army practice that leads to misassignment and points to the intention of the positions to be fully manned. We have not attempted to cost the resulting decrease in productivity from skill misassignment, although under all cost scenarios it represents a real cost.

ital and labor, but between different forms of labor. This is impossible to do accurately on the basis of service manpower costs alone because the conventions for utilization of people vary so widely among types of labor. The translation to standard manyear cost facilitates this labor-type comparison by estimating the cost of a military (or civil service) manyear on the same delivered-hours basis as that most frequently used by contractors.*

9.4.1 The Opportunity Cost of Unworked Time

The costs covered in the previous sections represent the actual cost per year of an enlisted serviceman. The cost of a job, in an economic cost model, must also reflect the fact that an individual supplies more or less than the standard manyear of labor. Absences from work include holiday and leave and transience, prison and patient time (TPP). Time spent in formal, informal and on-the-job training is included under the training cost elements. The annual amount of productive time is calculated in hours by:

(9.2) $HP = HR - LV$.

LV = hours spent on leave, holidays and TPP
HR = standard number of hours by which a position is measured, usually 2080

Our immediate aim is to calculate a position-specific hourly work rate:

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* The standard manyear is often represented as 2080 manhours as if it were standard to deliver, at least on average, an eight hour day.

(9.3) $W = C_{14}/HP$,

which will serve as our basis for cost comparisons.

To arrive at a Standard Manyear Cost we simply take the product of the number of hours a served in a standard manyear and the position-specific work hourly rate:

(9.4) $SMC = HR \cdot W$,

a cost to compare with the costs offered by civilian contractors, if we bear in mind they estimate their costs on the basis of a standard manyear also.

Reformulating Equation 9.2 and multiplying by W we get:

(9.5) $HR \cdot W = HP \cdot W + LV \cdot W$,

or

(9.6) $SMC = C_{14} + DT$,

where DT is the downtime cost, due to leave, holidays and TPP.

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APPENDIX A: MANAGEMENT INFORMATION SYSTEM DOCUMENTATION

MANAGEMENT INFORMATION SYSTEM DOCUMENTATION

The MIS provides a user friendly means to apply the AMCOS cost data to analyses of particular Army units. Simply, the tool aids the specification, filing, retrieval and re-specification of manpower units. When the unit has been completely specified, the MIS addresses the AMCOS data base and calculates manpower costs for the unit.

At this stage in the development of AMCOS the Management Information System is quite primitive. Design for its replacement has already begun as interested users find potential uses not yet provided by this prototype facility. In part, the redesign will require alteration of the AMCOS data base structure to provide cost breakouts at lower levels. Further, it is envisioned that the model interface will be accessible from the Army FORECAST network.

Introduction

The prototype AMCOS MIS has been designed particularly for the manpower cost analysis of Army units. It has been implemented as a computer program intended to operate on an IBM PC, running under PC-DOS 2.0 or higher. The program will also work on 100% PC compatible machines.

In the following, we describe specific hardware requirements needed to run the program. We provide instructions to be followed for installation, and for getting the MIS up and running. Detailed descriptions are given of the various unit specification facilities

and options for printing cost tables. Last, we provide an example of a simple work session which may be followed to gain familiarity with the AMCOS MIS.

Hardware Requirements

A minimal hardware configuration would consist of an IBM PC with 256 kilobytes of random access memory (RAM), a monochrome monitor and one disk drive.

The microcomputer must also support the PC-DOS disk operating system (DOS). Various PC-DOS versions now exist: the program requires that its host run under version 2.0 or a later version. The user must supply the DOS software.

Installation and Startup

The MIS software is provided on two floppy diskettes. One is labelled "AMCOS MIS" and the other "AMCOS Data." Different procedures must be followed according to whether the microcomputer is already on and running.

1. Put the "MIS" diskette in the A> drive.
2. If the host microcomputer is on and running, reset the system by pressing the three **CTRL**, **ALT** and **DEL** keys together. If the system is off, simply start it.
3. After a while the screen will display the AMCOS sign-on menu, requesting the user to select among the Army components. Only the Enlisted models have been installed at this point.
4. Wait while MOS data is being loaded into memory. After half a minute or so, a new screen appears.
5. Remove the "MIS" diskette from the A> drive and replace it with the "Data" diskette.
6. You are ready to start.

Anytime you wish to use AMCOS MIS, follow steps 1 to 6, above. Do not forget to replace the "MIS" disk with the "Data" diskette, after the MOS data has been loaded.

Specifying a Manpower Unit

It is assumed the reader has successfully started the AMCOS MIS, and that a menu has appeared (at the bottom of the screen). The first five choices, **Select**, **Remove**, **Clear**, **File** and **Lookup**, are facilities used in specifying an Army unit. The **Info** option displays the MOS title. **Print** switches control to the cost calculation and printing modules, while **Quit** returns control to the operating system, ending the session. In this section we describe the operation of the first five options.

Each option is invoked by typing its initial letter in either upper or lower case. The **Select** option is used to select an MOS. Typing "S" causes the following to appear above the menu line:

Type MOS name (3 characters) >

Now enter three characters identifying an MOS: for example type **11B** to select infantrymen. A line will appear on the screen composed of the MOS identifier on the left and numbers under the valid paygrades E-2 to E-9, for the MOS selected. These will be zeros if you are working with a new data set.

A cursor will also appear underneath the first number displayed. This is a pointer that indicates which data element are working with. You can move the cursor between paygrades and MOSs

with the four arrow keys and the **HOME** and **END** keys. When the cursor is on the cell you are concerned with, enter the number of positions of that type in the unit.

For example, if the unit provides for four 11B20 positions, proceed as follows: 1) select MOS 11B, using the **SELECT** option, or by moving the cursor; 2) move the cursor to pay grade E-5 with an arrow key; 3) enter the number 4 (which appears first for editing on the line above the menu line) and press the **ENTER** key. The number 4 will appear, highlighted by the cursor, on the 11B line and under pay grade E-5.

The screen will only show nine selected MOSs at a time. The alphanumeric MOS ordering is always preserved. Those MOSs not shown may be re-displayed by either selecting the MOS of interest or by moving the cursor with the arrow keys. The block of consecutive selected MOSs will scroll upward or downward until the desired MOS is displayed. Typing the **HOME** key returns the cursor to the top of the list of selected MOSs; similarly the **END** key takes the cursor to the lowest grade of the last MOS in the list.

AMCOS covers 359 MOSs. If the MOS you select is not one of these, a message will announce that the MOS selected is not recognized. The message disappears and operation continues with the press of any key.

If you wish to remove an MOS from the unit, move the cursor to the MOS by use of the arrow keys or by selecting it. Then remove it with the **Remove** option by typing an upper or lower case "R." The

line for that MOS will disappear and the MOS list will readjust accordingly.

To remove all MOSs currently selected, type "C" thus invoking the **Clear** option. The screen will show no MOSs: the program is ready for another unit to be specified.

The two last unit specification options, **File** and **Lookup**, are used to save (file away) a current unit specification, and to retrieve (look up) a unit specification previously filed. If either of these options are chosen, a file name is requested.

On filing away a specification, if there is already a unit with the same name, a warning appears and questions whether this old file is to be replaced. If no match is made when retrieving a file, the program so states and awaits the next command.

Currently there is no facility provided to obtain a list of units on file. Such a list may be obtained, however, by quitting the model, and getting a directory listing with the DOS system command **DIR *.UNI**. Note that all filed units possess the file name extent ".UNI" which is appended by the program.

Printing the Costs

Once a unit has been specified, budget and economic cost estimates may be obtained both on screen and on hard copy. Cost estimates can be obtained for each of the MOSs comprising the unit, or for the unit as a whole. The costs may be total manpower costs, or the unit average (per soldier) costs.

Type "P" to invoke the **Print** option.

In essence there are four binary choices to be made: 1) between resource and budget costs; 2) between total or average (per man) costs; 3) whether costs are desired for the unit as a whole, or for each unit member MOS; and 4) whether the costs are to be displayed on the screen or printed on hard copy (by the printer attached to the computer).

The line above the menu line displays the current print configuration. Initially the default configuration is to:

Print marginal **RESOURCE** cost **TOTAL** for **whole UNIT** on the **SCREEN**

The menu line, on the other hand shows the options not selected. It also offers an **EXECUTE** option, the selection of which calculates the costs and displays them, as requested in the report configuration line.

A further option, to **CONTINUE**, ends the cost calculation and printing module and returns to the unit selection module. Before returning, however, to unit specification, an option is offered to print the composition of the unit on hard copy. The composition printout lists, in alpha-numeric MOS order, and by pay grade, the number of soldier positions allotted to the unit.

A Work Session

Working through this example with the AMCOS MIS will familiarize the beginner with its use and capabilities. The unit to be costed is a light infantry platoon with the following enlisted positions:

GRADE	MOS	NUMBER
E6	11B	1
E5	11B	3
	11H	1
E4	11B	10
	11H	6
	05C	1
E3	11B	12
	11H	6
		40

Our objective will be to enter this unit specification and to obtain printed tables of unit costs and composition. First we call up the program, following one of the Installation procedures detailed above. As the program starts, enter **1** to select the enlisted cost model. The specification screen appears once the data have loaded. Change the diskettes. The menu line as the bottom of the screen displays:

Select Remove Clear File Lookup Info Print Quit

The initial letter of each option is highlighted indicating each choice may be selected by typing the respective initial letter (in either upper or lower case). We proceed as follows.

Type **C** to clear the selection (not necessary if no selection has yet been made). Type **S** to select MOS 11B. In response to the prompt, type **11B**. Similarly select MOSs 11H and 05C.

The screen will now display three lines of zeros, each line labelled to the left by the MOS identifier and the corresponding Career Management Field (CMF). The zeros will be displayed for valid (MOS specific) pay grades only. One of the zeros will be highlighted, the one to the left and on the 05C line. Press the → (right arrow) key twice to move the cursor to the zero under pay

grade E4. [If the cursor does not move, press the **CTRL** and **X** keys together, strike the **NUMLOCK** key, and try again.]

Press the 1 number key: notice that the number is displayed (for correction before entry) on the line above the menu line at the bottom of the screen. Press the **ENTER** key and the number will be entered at the highlighted location.

Now move the cursor down a line--by pressing the ↓ (down arrow) key--to the MOS 11B line. Enter the following sequence:

```
<-   1   2   ->   1   0   ->   3   ->   1   ENTER
↓    <-  1   <-   6   <-   6   ENTER
```

The screen should look like this:

ENLISTED MANPOWER COST MODEL

FY 1984 DATA

UNIT COST ANALYSIS FACILITY

MOS	CMF	E-1/2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
05C	31	0	0	1	0	0			
11B	11	0	12	10	3	1	0	0	0
11H	11	0	[6]	6	1	0	0		

Select **Remove** **Clear** **File** **Lookup** **Info** **Print** **Quit**

We may now file this unit specification away for later: press **F** and enter a file name, **LIGHTINF** for example. To demonstrate two other features, proceed as follows:

Type **C** to clear the specification. Now type **L** to lookup (i.e., retrieve) the unit just saved: respond with the file name with which you filed away the unit specification.

We shall now proceed to print costs for the platoon. Type **P** and notice that two new lines have appeared at the bottom of the screen:

```
  Print marginal RESOURCE cost TOTAL for whole UNIT on the SCREEN
Execute  Continue  Budget      Per man        MOS          Hard copy
```

The top line indicates the configuration of the default print setting. There are eight different cost settings as defined by the three alternatives:

1) Resource (economic), or budget model.

2) Total dollar cost, or cost per soldier.

3) Whole unit costs, or costs for each component MOS.

In addition, the results may be displayed on the screen, or hardcopy printed on the attached printer--be sure the printer is switched on and "on-line."

Once you have set the print configuration as you would like it, press **E** to execute your selections. You can select any or all of these options.

When no more cost analyses for the unit are wanted press **C** to continue. You will be asked whether you wish a printout (hard copy) of the unit composition, MOS by MOS. Then the facility returns to the unit specification screen.

APPENDIX B: COMPARISON OF MANPOWER COSTS FOR M113 AND BFVS MECHANIZED INFANTRY BATTALIONS

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS (in Thousands of dollars)

07245J220 M113 MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	SUM
1. Basic Pay .	1801	3717	1940	1202	575	202	27	9467
2. S.R.B. .	24	160	57	19	12	6	0	280
3. Special Pays .	25	38	20	15	6	1	0	107
4. V.H.A. .	31	44	29	23	12	5	0	147
5. Overseas .	18	78	33	15	4	1	0	151
6. Allowances .	548	1147	603	346	149	46	5	2847
7. Benefits .	37	107	74	66	38	11	1	337
8. Accession .	727	990	120	0	0	0	0	1838
9. Adv.Training .	0	0	9	69	0	0	0	79
10. Rotation .	186	397	109	35	13	5	0	748
11. Separation .	97	197	61	17	6	3	0	383
12. V.E.A.P. .	0	0	0	0	0	0	0	0
13. Retirement .	54	99	78	69	38	12	1	353
SOLDIER COST .	3552	6979	3138	1881	857	295	37	16743
Down Time Cost .	549	1079	485	291	132	45	5	2590
POSITION COST .	4102	8059	3624	2172	989	341	43	19333

ENLISTED MANPOWER COST MODEL

1984 DATA

MARGINAL BUDGET COSTS (in Thousands of dollars)

07245J220 M113 MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	SUM
1. Basic Pay .	1801	3717	1940	1202	575	202	27	9467
2. S.R.B. .	27	175	62	21	13	7	0	307
3. Special Pays .	25	38	20	15	6	1	0	107
4. V.H.A. .	31	44	29	23	12	5	0	147
5. Overseas .	18	78	33	15	4	1	0	151
6. Allowances .	304	683	375	218	92	31	2	1709
7. Benefits .	34	97	66	59	34	10	1	303
8. Accession .	33	15	2	0	0	0	0	52
9. Adv.Training .	0	0	0	9	0	0	0	11
10. Rotation .	186	397	109	35	13	5	0	748
11. Separation .	97	197	61	17	6	3	0	383
SOLDIER COST .	2560	5444	2703	1618	759	268	33	13389

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS (in dollars)

07245J220 M113 MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	AVG
1. Basic Pay .	9099	10470	12437	15219	18563	22515	27870	11420
2. S.R.B. .	125	452	366	245	400	723	0	338
3. Special Pays .	126	107	132	201	211	132	0	129
4. V.H.A. .	158	123	189	299	407	607	821	177
5. Overseas .	93	221	213	198	140	160	98	183
6. Allowances .	2769	3231	3868	4388	4821	5171	5460	3434
7. Benefits .	188	303	476	843	1252	1249	1021	406
8. Accession .	3673	2791	770	5	1	11	0	2218
9. Adv.Training .	0	0	63	875	4	0	31	95
10. Rotation .	944	1119	704	444	423	564	751	902
11. Separation .	490	557	395	216	197	355	311	462
12. V.E.A.P. .	0	0	0	0	0	0	0	0
13. Retirement .	275	281	502	875	1229	1369	1321	426
SOLDIER COST .	17944	19660	20121	23813	27654	32860	37684	20197
Down Time Cost .	2776	3041	3113	3684	4278	5083	5829	3124
POSITION COST .	20720	22702	23234	27498	31933	37944	43513	23321

ENLISTED MANPOWER COST MODEL

1984 DATA

MARGINAL BUDGET COSTS (in dollars)

07245J220 M113 MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	AVG
1. Basic Pay .	9099	10470	12437	15219	18563	22515	27870	11420
2. S.R.B. .	137	494	401	267	438	790	0	370
3. Special Pays .	126	107	132	201	211	132	0	129
4. V.H.A. .	158	123	189	299	407	607	821	177
5. Overseas .	93	221	213	198	140	160	98	183
6. Allowances .	1538	1924	2404	2769	2999	3527	2995	2062
7. Benefits .	172	274	423	746	1125	1154	1005	365
8. Accession .	169	42	18	5	1	11	0	63
9. Adv.Training .	4	0	5	118	0	0	31	13
10. Rotation .	944	1119	704	444	423	564	751	902
11. Separation .	490	557	395	216	197	355	311	462
SOLDIER COST .	12934	15336	17327	20489	24510	29818	33882	16151

ENLISTED MANPOWER COST MODEL

UNIT COMPOSITION FOR

07245J220 M113 MECHANIZED INFANTRY BATTALION

	E-1/2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
05B	0	1	3	0				
05C	0	1	1	1	0			
11B	0	96	205	78	36	15	8	0
11C	0	9	14	10	2	1		
11H	0	20	44	10	10	3		
19D	0	6	12	6	4	1		
31V	0	1	5	1	5	1	0	
36K	0	1	3	1				
44B	0	0	1	0				
45T	0	0	2	0				
52D	0	1	1	0	0			
54E	0	0	1	6	1	0		
63B	0	2	2	0	0	0	0	
63S	0	0	1	0				
63T	0	20	21	16	2	6	1	
64C	0	12	6	0	2	0		
71D	0	0	0	1	0	0	0	0
71G	0	12	8	0	0	0	0	
71L	0	0	2	0	0	0	0	0
71M	0	0	1	0	0	0	0	0
75B	0	2	2	1	1			
75Z						1	0	0
76C	0	0	5	1				
76W	0	4	3	2	0	0	0	0
76Y	0	3	2	7	7	1		
91B				10	1	1	0	0
91C				0	2	0	0	0
94B	0	7	10	5	5	1	0	0
96B	0	0	0	0	1	0	0	
98Z							0	1

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS (in Thousands of dollars)

07245J210 BFVS MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	SUM
1. Basic Pay .	1943	3635	2049	1155	669	202	27	9684
2. S.R.B. .	28	186	58	21	15	6	0	316
3. Special Pays .	6	6	4	5	2	1	0	26
4. V.H.A. .	31	32	26	18	10	5	0	125
5. Overseas .	10	30	16	10	3	1	0	72
6. Allowances .	597	1131	635	333	173	46	5	2924
7. Benefits .	39	102	79	64	44	11	1	342
8. Accession .	691	851	93	0	0	0	0	1636
9. Adv.Training .	0	0	10	56	0	0	0	67
10. Rotation .	109	169	55	20	11	5	0	371
11. Separation .	44	81	31	9	4	3	0	174
12. V.E.A.P. .	0	0	0	0	0	0	0	0
13. Retirement .	57	93	83	67	44	12	1	359
SOLDIER COST .	3559	6322	3143	1763	980	295	37	16103
Down Time Cost .	550	978	486	272	151	45	5	2491
POSITION COST .	4109	7301	3629	2036	1132	341	43	18595

ENLISTED MANPOWER COST MODEL

1984 DATA

MARGINAL BUDGET COSTS (in Thousands of dollars)

07245J210 BFVS MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	SUM
1. Basic Pay .	1943	3635	2049	1155	669	202	27	9684
2. S.R.B. .	31	203	64	23	16	7	0	346
3. Special Pays .	6	6	4	5	2	1	0	26
4. V.H.A. .	31	32	26	18	10	5	0	125
5. Overseas .	10	30	16	10	3	1	0	72
6. Allowances .	344	696	396	221	105	31	2	1799
7. Benefits .	35	92	70	57	40	10	1	308
8. Accession .	33	12	1	0	0	0	0	48
9. Adv.Training .	0	0	1	10	0	0	0	12
10. Rotation .	109	169	55	20	11	5	0	371
11. Separation .	44	81	31	9	4	3	0	174
SOLDIER COST .	2591	4963	2717	1532	864	268	33	12971

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS (in dollars)

07245J210 BFVS MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	AVG
1. Basic Pay .	9083	10417	12495	15200	18608	22515	27870	11407
2. S.R.B. .	134	533	357	284	419	723	0	373
3. Special Pays .	28	19	29	71	56	132	0	31
4. V.H.A. .	145	93	163	238	298	607	821	148
5. Overseas .	49	87	97	138	106	160	98	85
6. Allowances .	2793	3242	3874	4392	4827	5171	5460	3444
7. Benefits .	183	293	482	852	1249	1249	1021	403
8. Accession .	3229	2439	568	1	0	11	0	1927
9. Adv.Training .	0	0	65	749	3	0	31	80
10. Rotation .	511	486	335	270	313	564	751	438
11. Separation .	205	234	189	122	130	355	311	205
12. V.E.A.P. .	0	0	0	0	0	0	0	0
13. Retirement .	266	267	508	885	1232	1369	1321	423
SOLDIER COST .	16631	18116	19167	23208	27248	32860	37684	18967
Down Time Cost .	2573	2803	2965	3590	4215	5083	5829	2934
POSITION COST .	19204	20919	22132	26799	31463	37944	43513	21902

ENLISTED MANPOWER COST MODEL

1984 DATA

MARGINAL BUDGET COSTS (in dollars)

07245J210 BFVS MECHANIZED INFANTRY BATTALION

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9	AVG
1. Basic Pay .	9083	10417	12495	15200	18608	22515	27870	11407
2. S.R.B. .	147	582	391	311	458	790	0	408
3. Special Pays .	28	19	29	71	56	132	0	31
4. V.H.A. .	145	93	163	238	298	607	821	148
5. Overseas .	49	87	97	138	106	160	98	85
6. Allowances .	1611	1997	2417	2915	2922	3527	2995	2119
7. Benefits .	167	265	429	754	1123	1154	1005	363
8. Accession .	157	36	11	1	0	11	0	57
9. Adv.Training .	2	0	7	135	0	0	31	14
10. Rotation .	511	486	335	270	313	564	751	438
11. Separation .	205	234	189	122	130	355	311	205
SOLDIER COST .	12110	14222	16567	20160	24019	29818	33882	15278

ENLISTED MANPOWER COST MODEL

UNIT COMPOSITION FOR

07245J210 BFVS MECHANIZED INFANTRY BATTALION

	E-1/2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
05B	0	1	3	0				
05C	0	1	1	1	0			
11B	0	0	0	0	0	0	8	0
11C	0	9	14	10	2	1		
11H	0	12	28	6	6	3		
11M	0	96	205	90	36	16		
19D	0	6	12	6	4	1		
31V	0	3	5	1	5	1	0	
36K	0	1	3	1				
44B	0	0	2	0				
45T	0	5	6	0				
52D	0	1	1	0	0			
54E	0	0	1	6	1	0		
63B	0	3	2	1	0	0	0	
63S	0	0	1	0				
63T	0	25	20	13	7	6	1	
64C	0	16	12	2	2	0		
71D	0	0	0	1	0	0	0	0
71G	0	19	8	0	0	0	0	
71L	0	0	2	0	0	0	0	0
71M	0	0	1	0	0	0	0	0
75B	0	2	2	1	1			
75Z						1	0	0
76C	0	0	5	1				
76W	0	4	3	2	0	0	0	0
76Y	0	3	2	7	7	1		
91B				10	1	1	0	0
91C				0	2	0	0	0
94B	0	7	10	5	1	5	0	0
96B	0	0	0	0	1	0	0	
98Z							0	1

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS

11M

FIGHTING VEHICLE INFANTRYMAN

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7
1. Basic Pay	9060	10334	12419	15059	18416
2. S.R.B.	185	722	447	377	571
3. Special Pays	0	1	3	10	0
4. V.H.A.	123	74	145	178	183
5. Overseas	8	19	18	87	57
6. Allowances	2782	3234	3847	4378	4810
7. Benefits	178	281	461	823	1222
8. Accession	3326	2601	665	0	0
9. Adv.Training	0	0	0	591	0
10. Rotation	35	57	32	52	16
11. Separation	116	148	113	70	66
12. V.E.A.P.	0	0	0	0	0
13. Retirement	256	257	493	862	1193
SOLDIER COST	16069	17728	18643	22487	26534
Down Time Cost	2486	2743	2885	3479	4105
POSITION COST	18555	20471	21528	25966	30639

ENLISTED MANPOWER COST MODEL

1984 DATA

REAL MARGINAL COSTS

11B

INFANTRYMAN

COST ELEMENTS	E-3	E-4	E-5	E-6	E-7	E-8	E-9
1. Basic Pay .	9101	10429	12310	15043	18417	22529	27849
2. S.R.B. .	155	578	462	360	430	713	1061
3. Special Pays .	188	147	202	268	317	149	84
4. V.H.A. .	155	126	194	298	441	613	852
5. Overseas .	106	242	238	216	152	165	113
6. Allowances .	2737	3215	3831	4366	4799	5162	5478
7. Benefits .	188	298	450	784	1235	1247	1032
8. Accession .	4185	3222	1071	7	3	13	3
9. Adv.Training .	0	0	0	978	0	0	0
10. Rotation .	967	1122	712	425	321	517	543
11. Separation .	695	692	480	269	238	375	385
12. V.E.A.P. .	0	0	0	0	0	0	0
13. Retirement .	274	278	483	828	1197	1365	1379
SOLDIER COST .	18751	20349	20433	23842	27550	32848	38779
Down Time Cost .	2901	3148	3161	3689	4262	5082	5999
POSITION COST .	21652	23497	23594	27531	31812	37930	44778

END

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